National Park Service
U.S. Department of the Interior

Southeast Coast Network
Atlanta, Georgia

Vital Signs Monitoring in the Southeast Coast Inventory & Monitoring Network

Phase I (DRAFT) Report

Table of Contents

1. Introduction and Background

Program Purpose and Scope

The Southeast Coast Network (SECN) monitoring plan is being developed over a multi-year period following specific guidance from the National Park Service, Washington Office (WASO). Networks are required to document monitoring planning progress in three distinct phases and to follow a standardized reporting outline. Each phase report requires completion of specific portions of the outline.

This Phase I Report emphasizes work on Chapter 1 (Introduction and Background), Chapter 2 (Conceptual Models) and Chapter 11 (Literature Cited), but includes partial work on several other chapters (3, 6, and 8). Some chapters will remain unwritten until future Phase Reports are completed. This document presents the SECN framework and approach to vital signs monitoring planning and a summary of work accomplished to date. Specifically the Phase I Report summarizes existing information on National Park Service and related natural resource monitoring programs within the network, presents an overview of biological and physical resources of network parks, describes monitoring goals and needs, and presents a theoretical framework with conceptual models for guiding future efforts.

Phase II and Phase III Reports will be developed during FY 2005 and FY2006, respectively. The Phase II Report will describe the initial set of vital signs with supporting rationale and prioritization, as well as provide updated information presented in the Phase I Report. The Phase III Report will constitute the first full working version of the SECN Monitoring Plan and will present results of the monitoring design work and implementation planning.

The Importance of Long- Term Monitoring

In 1992, the National Academy of Sciences (1992) reviewed the natural resource management program of the National Park Service (NPS) and concluded, “If this agency is to meet the scientific and resource management challenges of the twenty-first century, a fundamental metamorphosis must occur.” Indeed, that metamorphosis materialized when the National Park Service implemented a strategy to standardize inventories and monitoring of natural resources on a programmatic basis throughout the agency. The effort was undertaken to ensure that the approximately 270 park units with significant natural resources possessed the resource information needed for effective, science-based, managerial decision-making and resource protection. The national strategy consists of a framework having three major components:

1. Completion of basic natural resource inventories in support of future monitoring efforts;
2. Creation of experimental Prototype Monitoring Programs to evaluate alternative monitoring designs and strategies; and
3. Implementation of operational Vital Signs monitoring in all natural resource parks.

A fundamental goal of the National Park Service is to protect or maintain natural ecosystem structure and function in national parklands. Knowing the condition of natural resources in national parks is crucial to the Service's ability to protect and manage parks. National park managers across the country confront increasingly complex and challenging issues and are asked to provide scientifically credible data to defend management actions. Many of the threats to park resources, such as invasive species and air and water pollution, come from outside the park boundaries, requiring a landscape approach and integrated long-term monitoring to understand and protect the park's natural resources.

In this plan, we define integrated monitoring as “systematic, consistent, and simultaneous measurements of physical, chemical, biological, and human-effects variables through time and at specified locations in a manner that is designed to effectively inform adaptive management decisions.” In theory, by monitoring a wide range of variables at long-term sites, it is possible to gain an understanding of how ecosystems function and respond to change (Bricker and Ruggiero 1998). Coupling monitoring with research and modeling might make it possible to predict what will happen in the future and, if necessary, devise appropriate response strategies. Ecological monitoring is vital to park management for a variety of reasons:

- Ecological monitoring provides understanding and insight into long-term ecological phenomena and the function of complex ecosystems across park and network boundaries.
- Ecological monitoring provides the basis for evaluating whether NPS is achieving mandates and policies of protecting park natural resources. One of the major shortcomings of most of natural resource management and conservation plans has been the absence of a comprehensive ecological monitoring program (Kremen et al. 1993).
- Ecological monitoring allows for detection of long-term adverse effects of human activities on park ecosystems. Because of the delay between a human disturbance and a subsequent response, long-term ecological monitoring provides significant data.
- Ecological monitoring provides information to inform stakeholders, park visitors, and the public about the status and threats to park ecosystems, organisms, and ecological processes.

Legislative Mandates Linking Monitoring to Natural Resources Management

The enabling legislation establishing the National Park Service and its individual park units clearly mandates as the primary objective, the "*protection, preservation, and conservation of park resources, in perpetuity for the use and enjoyment of future generations*" (16 USC 1). National Park Service policy and recent legislation (National Parks Omnibus Management Act of 1998) require that park managers know the condition of natural resources under their stewardship and monitor long-term trends in those resources in order to fulfill the NPS mission of conserving parks unimpaired. The laws and management policies that follow provide the mandate for inventorying and monitoring in national parks.

National park managers are directed by federal law and National Park Service policies and guidance to know the status and trends in the condition of natural resources under their stewardship in order to fulfill the NPS mission to conserve parks unimpaired (see Appendix 2: Legislation Relevant to SECN Vital Signs Monitoring). The mission of the National Park Service (National Park Service Organic Act, 1916) is:

> *"...to promote and regulate the use of the Federal areas known as national parks, monuments, and reservations hereinafter specified by such means and measures as conform to the fundamental purposes of the said parks, monuments, and reservations, which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."*

Congress strengthened the National Park Service's protective function, and provided language important to recent decisions about resource impairment, when it amended the Organic Act in 1978 to state that *"the protection, management, and administration of these areas shall be conducted in light of the high public value and integrity of the National Park System and shall not be exercised in derogation of the values and purposes for which these various areas have been established…."*

More recently, the National Parks Omnibus Management Act of 1998 established the framework for fully integrating natural resource monitoring and other science activities into the management processes of the national park system. The act charges the secretary of the interior to "*continually improve the ability of the National Park Service to provide state-of-the-art management, protection, and interpretation of and research on the resources of the National Park System,*" and to *"assure the full and proper utilization of the results of scientific studies for park management decisions*." Section 5934 of the act requires the secretary of the interior to develop a program of "*inventory and monitoring of National Park System resources to establish baseline information and to provide information on the long-term trends in the condition of National Park System resources*."

Congress reinforced the message of the National Parks Omnibus Management Act of 1998 in its text of the FY 2000 Appropriations bill:

> *"The Committee applauds the Service for recognizing that the preservation of the diverse natural elements and the great scenic beauty of America's national parks and other units should be as high a priority in the Service as providing visitor services. A major part of protecting those resources is knowing what they are, where they are, how they interact with their environment and what condition they are in. This involves a serious commitment from the leadership of the National Park Service to insist that the superintendents carry out a systematic, consistent, professional inventory and monitoring program, along with other scientific activities, that is regularly updated to ensure that the Service makes sound resource decisions based on sound scientific data."*

The 2001 NPS Management Policies updated previous policy and specifically directed the service to inventory and monitor natural systems:

> *"Natural systems in the national park system, and the human influences upon them, will be monitored to detect change. The Service will use the results of monitoring and research to understand the detected change and to develop appropriate management actions."*
>
> *Further, "The Service will:*
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> - *Identify, acquire, and interpret needed inventory, monitoring, and research, including applicable traditional knowledge, to obtain information and data that will help park managers accomplish park management objectives provided for in law and planning documents.*
> - *Define, assemble, and synthesize comprehensive baseline inventory data describing the natural resources under its stewardship, and identify the processes that influence those resources.*
> - *Use qualitative and quantitative techniques to monitor key aspects of resources and processes at regular intervals.*
> - *Analyze the resulting information to detect or predict changes, including interrelationships with visitor carrying capacities, that may require management intervention, and to provide reference points for comparison with other environments and time frames.*
> - *Use the resulting information to maintain-and, where necessary, restore-the integrity of natural systems" (2001 NPS Management Policies).*

Additional statutes that provide legal direction for expending funds to determine the condition of natural resources in parks and specifically guide the natural resource management of network parks are summarized in Appendix 2.

Goals of the Vital Signs Monitoring Program

Table 1-1. Goals of the Southeast Coast Network Vital Signs Monitoring Program

Vital Signs Monitoring Goals
1. Determine status and trends in selected indicators of the condition of park ecosystems to allow managers to make better-informed decisions and to work more effectively with other agencies and individuals for the benefit of park resources.
2. Provide early warning of abnormal conditions of selected resources to help develop effective mitigation measures and reduce costs of management.
3. Provide data to better understand the dynamic nature and condition of park ecosystems and to provide reference points for comparisons with other, altered environments.
4. Provide data to meet certain legal and congressional mandates related to natural resource protection and visitor enjoyment.
5. Provide a means of measuring progress toward performance goals.

The overarching purpose of natural resource monitoring in parks is to develop scientifically sound information on the current status and long-term trends in the composition, structure, and function of park ecosystems, and to determine how well current management practices are sustaining those ecosystems (http://www.nature.nps.gov/im/monitor/#GoalsObj). The monitoring program of the Southeast Coast Network will be designed around the five broad, servicewide goals common to all networks within the Vital Signs Monitoring Program (Table 1-1).

Environmental Setting of the Southeast Coast Network

Network Parks

The Southeast Coast Network contains twenty parks, seventeen of which contain significant and diverse natural resources (Table 1-2). In total, SECN parks encompass more than 178,000 acres of federally-managed land across North Carolina, South Carolina, Georgia, Alabama, and Florida. The parks span a wide diversity of cultural missions also, including four National Seashores, two National Historic Sites, two National Memorials, seven National Monuments, two national Military Parks, as well as a National Recreation Area, National Battlefield, and Ecological and Historic Preserve. The parks range in size from slightly more than 20 to nearly 60,000 acres, and when considered with non-federal lands jointly managed with SECN parks the Network encompasses more than 253,000 acres.

Table 1-2
Parks of the Southeast Coast Network with significant Natural Resources.
[Park codes in italics are administered by the nearest non-italicized entry above]

Park Code	Park	Significant Natural Resources?	Federal Acres	Non-Federal Acres	Total Acres
CANA	Canaveral National Seashore	Yes	**57,647.69**	**14**.00	**57,661.69**
CAHA	Cape Hatteras National Seashore	Yes	34,500.00	--	34,500.00
FORA	Fort Raleigh National Historic Site	Yes	355.00	--	355.00
WRBR	Wright Brothers National Memorial	No	421.00	--	421.00
CALO	Cape Lookout National Seashore	Yes	25,173.62	3,069.74	28,243.36
CASA	Castillo de San Marcos National Monument	No	20.18	0.33	20.51
FOMA	Fort Matanzas National Monument	Yes	298.00	--	298.00
CHAT	Chattahoochee River National Recreation Area	Yes	5,462.16	5,437.84	10,900.00
CONG	Congaree National Park	Yes	21,768.79	4,663.45	26,432.24
CUIS	Cumberland Island National Seashore	Yes	18,849.14	17,566.69	36,415.83
FOFR	Fort Frederica National Monument	Yes	239.19	2.23	241.42
FOPU	Fort Pulaski National Monument	Yes	5,365.13	257.97	5,623.10
FOSU	Fort Sumter National Monument	Yes	194.37	0.23	194.60
CHPI	Charles Pinckney National Historic Site	No	28.00	--	28.00
MOCR	Moores Creek National Battlefield	Yes	87.75	--	87.75
HOBE	Horseshoe Bend National Military Park	Yes	2,040.00	--	2,040.00
KEMO	Kennesaw Mountain National Battlefield Park	Yes	2,879.60	4.54	2,884.14
OCMU	Ocmulgee National Monument	Yes	701.54	--	701.54
TIMU	Timucuan Ecological and Historic Preserve	Yes	8,416.95	37,583.05	46,000.00
FOCA	Fort Caroline National Memorial	Yes	133.15	5.24	138.39
	Total		**184,581.26**	**68,605.31**	**253,186.57**

Canaveral National Seashore

The natural resources of Canaveral National Seashore include a diverse assemblage of wildlife, vegetative communities, geophysical features and natural processes reflecting the complexity of the land/lagoon/sea interface of east central Florida. Throughout the park, the relationship of land and water is paramount. From ephemeral wetlands to Atlantic beaches, the natural processes shaping the coastal environment are present in full diversity where change is the only constant.

Unlike many barrier islands, Canaveral has only a single dune ridge, averaging 12 feet in height. For the vast majority of its length the dune is quite stable, backed by a dense growth of saw palmetto (*Serenoa repens*) and several other species of hardy shrubs and grasses.

Mosquito Lagoon, extending along the backside of Canaveral's barrier island, is the northernmost part of the Indian River Lagoon. Containing the most diverse assemblage of aquatic species on the entire Eastern Seaboard, this 155-mile long lagoon has been designated as an Estuary of National Significance by the Environmental Protection Agency and an Outstanding Florida Water by the State of Florida. It contains one of the last significant populations of oysters on the entire Atlantic Coast that has not been depleted by over harvesting or pollution. Commercial shell fishing is extremely important to the local economy; recreational fishing and shrimping in the lagoon support a multimillion-dollar tourist industry. The estuary also acts as an important nursery area for a number of commercially important ocean-going species such as flounder, mullet, black drum and shrimp.

The park is located along the "frost line", resulting in a unique combination of temperate and subtropical plants found nowhere else in the Western Hemisphere. Several temperate species extend no farther south than Canaveral, while a number of subtropical species occur no farther north. Signs of this unusual mixture include Canaveral's hammocks, which contain an overstory dominated by temperate species and an understory comprised of subtropical plants. Another sign is the significant shift in vegetation along the edge of the lagoon from salt marsh cordgrass (*Spartina alterniflora*), which predominates in areas north of Canaveral, to mangrove species that predominate to the south.

Wildlife resources are considerable, ranging from a myriad of terrestrial and aquatic species inhabiting estuarine systems to small endemic populations of mammals living in the dunes. Canaveral is second only to Everglades National Park in number of federally protected species with 14. These include such species as the highly endangered West Indian manatee (*Trichechus manatus*), right whale (*Balaena glacialis*) and little known Atlantic salt marsh snake (*Nerodia fasciata taeniata*), who's entire known range consists of a single county in Florida. Canaveral's 24 miles of beach provides a critical nesting area for sea turtles, harboring 3,000 to 4,000 nests each year. The majority are loggerhead (*Caretta caretta*), with a smaller number of green (*Chelonia mydas*) and an occasional leatherback (*Dermochelys coriacea*). Mosquito Lagoon provides an important nursery area for juvenile sea turtles.

Boaters are coming into Canaveral National Seashore in increasing numbers due to the growing popularity of fly-fishing for redfish. This increases the destruction of seagrass beds, impacts to fisheries are unknown and manatees are highly affected. One of the very controversial and volatile issues among boaters in Florida is the establishment of slow speed zones to protect the West Indian manatee. Canaveral has supplied sighting data and engaged in several discussions with DEP on the proper placement of slow speed zones in the vicinity of the park. The park also assisted DEP with a boating survey to determine boating use patterns and areas that warrant speed restrictions.

Additionally, the park has long been concerned about the impact of commercial harvesting on hard clams (*Mercenaria* spp.) and eastern oysters (*Crassostrea virginica*). As shellfish have been depleted along other portions of the Atlantic coast, harvesting pressure has increased significantly in Mosquito Lagoon. Currently, the park requires all fishermen commercially harvesting shellfish to submit monthly catch logs. The accuracy of these logs is questionable and compliance has been poor.

Canaveral faces a number of complex issues regarding water quality in Mosquito Lagoon. These include septic tank, agricultural and industrial effluents, mosquito control activities, dredging of the Intracoastal Waterway, impacts of aquaculture, and increased boating activity. While water quality in Mosquito Lagoon is quite good overall, septic tank effluent and stormwater runoff from adjacent communities are threatening to degrade the lagoon. Currently park waters are closed to shellfishing when rainfall exceeds 1.5 inches in a 72-hour period, due to high fecal coliform levels. Another of the delicate issues with which Canaveral NS must grapple is mosquito control. In the designation of lands for NPS management, both NASA and the State of Florida stipulated that Canaveral NS must cooperate with the local mosquito control districts to control salt marsh mosquitoes. Canaveral and East Volusia Mosquito Control District have tested several measures, including Open Marsh Water Management (OMWM) techniques, to reduce the use of chemicals and to restore lost salt marsh.

Canaveral's most extensive resource management program involves sea turtle nest protection. The park documents 3,000 to 4,000 sea turtle nests each year. In the early 1980's, over 95 percent were destroyed by raccoons (N01). In 1984, the park began a nest screening program and has reduced depredation to 20-30 percent. However, this program is costly, averaging about $45,000 a year, and raises questions about the diverted predation pressure on other ground nesting species. Some parties recommend removing raccoons as a solution; in fact, MINWR does so with considerable success.

Canaveral NS is located in one of the most active lightning strike areas in the country. This, combined with the volatile fuels (particularly saw palmetto) and the extremely high fuel loads that have been allowed to accumulate, makes wildfire or human-ignited fire a serious threat. In addition, a number of vegetative communities and the animals that they support are dependent on periodic light to moderate fires. A Fire Management Plan has been completed which will allow the park to utilize prescribed fire to maintain and restore habitat for protected species such as the scrub jay, gopher tortoise and indigo snake

Like a number of other parks in the southeast, Canaveral faces a serious threat from the invasion of exotic plants, including Brazilian pepper (*Schinus terebinthifolius*), Australian pine (*Casuarina equisetifolia*) and century plant (*Agave sp.*). Brazilian pepper has spread throughout virtually all of the disturbed areas of Canaveral. A small number of *Melaleuca quinquenervia*, a species, which has severely impacted the Everglades, have been found in MINWR, less than 5 miles from the park boundary.

Exotic animals are also a threat to park resources. The feral hog (*Sus scrofa*) has become established in the southern half of Canaveral NS, particularly in the joint management area, and is seriously disrupting native vegetation. A voracious snake eater, it may also be affecting native snakes, including the protected eastern indigo snake (*Drymarchon corais couperi*). Another exotic animal impacting the park is the feral cat (*Felis catus*). During a two-year survey to determine the distribution of the southeastern beach mouse within Canaveral NS, no mice were captured in the northernmost section of the park (Stiner 1991; Stiner 1992). In addition, a number of potentially harmful amphibian and reptile species are expanding their ranges into Florida from tropical areas throughout the world. The park is attempting to detect these invaders through the long-term herpetofaunal monitoring program established by Southeastern Louisiana University in 1992.

Outer Banks Group - Cape Hatteras National Seashore

The Outer Banks Group includes Cape Hatteras National Seashore, Fort Raleigh National Historic Site, and Wright Brothers National Memorial. Cape Hatteras National Seashore is part of the east coast barrier island system. The Seashore contains 35,400 acres of land and 74 miles of virtually unspoiled beach. The U.S. Fish and Wildlife Service administers Pea Island National Wildlife Refuge within the boundary of the seashore. The intensely developed town of Nags Head borders the northern end of the Seashore and nine other villages border the seashore. Seashore marshes contribute heavily to primary estuarine productivity and provide habitat for numerous wildlife and aquatic species. Buxton Woods is located on the widest portion of the Seashore and is one of the largest maritime forests on the east coast. Approximately one-third of the forest, about 1,000 acres, lies within Park Service boundaries. Of the rest, about 800 acres are under state protection. The unique and varied habitats, mature broad-leafed evergreen forest and shrub, freshwater marsh, and bog support an unusual assemblage of aquatic, terrestrial, and avian species. Buxton Woods also overlies, protects, and provides for recharge of an important freshwater aquifer. The seashore has recently been designated a Globally Important Bird Area by the American Bird Conservancy because of the importance of the seashore habitats to avian breeding, migration, and wintering.

The ecological zonation of Cape Hatteras National Seashore is resultant in part on artificial alterations dating from the turn of the twentieth century. The most important perturbations were: (1) early efforts at mosquito control and waterfowl management which involved excavation of drainage ditches and construction of water control structures; and, (2) construction and vegetative stabilization of primary dunes along the length of the Seashore. Later changes were wrought when road construction included excavation of borrow ponds for road bed material. For the most part, these actions ended by the 1970’s, save for localized projects designed to protect specific and discrete portions of infrastructure.

Fort Raleigh NHS is located on the north end of a forested island between the barrier islands and the mainland of coastal North Carolina. The site’s 355 acres vary in elevation from sea level to 20 feet. Over half of Fort Raleigh is heavily forested with the remainder of the area supporting a visitor center, administrative and maintenance buildings, residences, the Waterside Theatre complex, and maintained open grassed areas. The maturing mixed deciduous and pine forest occurs on land that was previously disturbed, having been used for farming, grazing, transportation routes, and early settlement activities. Habitats include upland forests dominated by pines or a mixture of pine and hardwoods, brackish marsh, and swamp forests dominated by hardwoods. Species within the forest canopy include live oak, laurel oak, blackjack oak, American holly, dogwood, persimmon, and loblolly pine.

Wright Brothers NM covers over 421 acres in Kill Devil Hills, NC. The area's wind-blown sand flats and hills were the Wright brother's chosen practice field, and in 1903, the site of the first human flight. WRBR is situated on a barrier island within a rapidly developing residential and commercial community. The site has been transformed from its original relatively barren, dynamic state to a stabilized, dune and grass flat region. Grassed areas are vegetated with native and introduced grasses. Loblolly pine dominates the forested areas with laurel and live oak being the more predominant broad-leafed trees. Evergreen broad-leafed shrubs are interspersed within the forested area and between the forested and grassed areas. Much of the site is occupied by a visitor center, reconstructed buildings of the period, the monument itself, maintenance and residential structures, a paved airstrip, roads, walkways, and parking lots. Only limited vegetation and faunal inventories have been conducted at the site.

Developmental pressures outside the Park and visitor and recreational uses represent the major categories of threat to the integrity of natural resources on the CAHA Group parks. Adjacent property development has resulted in direct loss and fragmentation of habitat upon which numerous park wildlife species were partially dependent. Replacement of natural areas with impervious surfaces increases storm water runoff with its associated contaminants. Two potentially profound adverse impacts associated with adjacent development are contamination of ground and surface water by septic leachate and drawdown of the aquifer associated with excessive groundwater withdrawals. Other threats to natural resources include the introduction of exotic plants and animals, off-road vehicle use, and dredging of channels adjacent to the park.

Cape Lookout National Seashore

Largely undeveloped and accessible only by boat, Cape Lookout National Seashore is made up of three barrier islands covering 56 miles of the central coast of North Carolina. Most of the Seashore consists of North and South Core Banks, a 44-mile (71-km)-long barrier system oriented in a southwest to northeast direction and separated by the infrequently maintained New Drum Inlet. Cape Lookout extends into the Atlantic Ocean from its southern end, and abandoned Portsmouth Village is located at its northern end. The other barrier system within the Seashore, Shackelford Banks, extends westward from Cape Lookout and, while smaller (13 km long), is considered ecologically more diverse than Core Banks.

Core Banks is a long, narrow expanse of low dunes, maritime grasslands, and extensive salt marshes. Shrub thickets border the grassland in many places, and a low maritime forest occupies small areas of higher ground, such as Guthries Hammock. The islands are generally about 1 to 2 meters in elevation and 1 to 2 kilometers in width. For the most part, they are open and treeless. Windblown salt spray is carried across the entire barrier.

The wide berm and low, scattered dunes of Core Banks are characteristic of overwash-influenced barrier systems that have not been altered by man-made structures. When storms occur, the dunes here offer little resistance to flooding. Another process that has shaped these islands is the opening and closing of inlets. Dramatic changes in the position of inlets may take place in the period of a few years or even months. Many of the creeks in the marshes along Core Banks have probably been inlets in the past.

Although the physiography of Core Banks is more or less uniform along its length, the areas of Portsmouth Village and Cape Lookout are unique. Instead of exhibiting the typical zonation of a wide berm, low dunes, grasslands and shrub thickets, and salt marsh, the northern end of Portsmouth Island is characterized by vast tidal sand flats (averaging 1 km in width) located between the berm and the dunes of a series of marsh-fringed islands. At triangular Cape Lookout, continuous dunes similar to those on Shackleford Banks can be found on the southwest side, with several small freshwater marshes present in depressions between the dunes. With high dunes significantly reducing overwash, thickets have further stabilized the flats of the Cape's interior. A long spit extends from the western tip of Cape Lookout, where a jetty built in the early 1900s has encouraged accretion in this direction.

The dunes at the western end of Shackleford Banks are 10 to 13 meters (34 to 44 ft) above sea level and contain the highest elevations on Shackleford. The presence of high dunes on the western section may be due to the island's east-west orientation. Because the island faces the prevailing southwest winds rather than being parallel to them, sand is continually blown from the accreting beach into the dunes, where it is trapped and stabilized by the dune grass, *Uniola*. In the lee of this wall of rolling dune ridges, there is an impressive maritime forest, as well as several fresh and brackish marshes. On the side of the island that faces Back Sound, the beach is narrow and, in some places, the scarped bank is eroding away. Unlike most of the Outer Banks, the inner shore here is not fringed with salt marsh.

The western end of Shackleford is an accreting sand spit. Young dunes with *Spartina patens* and *Fimbristylis castanea* are forming along the edge of the curving berm, while areas of salt marsh are developing on the sound side of the spit. The eastern two-thirds of Shackleford Banks consists of low dunes, grassland, and salt marsh. In contrast to the western third, it is influenced by overwash. This part of the Island is characterized by dunes of less than 3 meters (10 ft) in height, open grassland (on overwash terraces), mesic meadows, and salt marsh. Shrub thickets occur in a few areas.

Specific issues of concern to Cape Lookout National Seashore include off-road vehicle use and associated impacts to dunes, threatened and endangered species, commercial fishing, military overflights, and non-native species.

Castillo de San Marcos and Fort Matanzas National Monuments

Fort Matanzas National Monument (FOMA) is located 14 miles south of St. Augustine on the northeast Atlantic coast of Florida. It encompasses of a total of 298 acres divided between the southern tip of Anastasia Island (108 acres) and the northern end of Rattlesnake Island (190 acres). Both are barrier islands separated from the Florida mainland by the Matanzas River and the Intracoastal Waterway.

The Anastasia Island portion of FOMA consists of stabilized beach dunes rising as much as 7.6 meters above sea level. Predominant habitats in this portion of the park include beaches along both the Matanzas River and the Atlantic shore, stabilized sand dunes supporting maritime forest, secondary dunes further inland, and salt marsh.

Most of Rattlesnake Island is less than 5 feet above sea level, though it rises to 15 ft at one point on it s northern end. Much of northern portion of Rattlesnake Island consists of sandy fill pumped in from dredging operations that maintain the boat channels in the Intracoastal Waterway. In addition to the habitats found on Anastasia Island, Rattlesnake Island supports slash pine and red bay woodlands, oyster shell beaches, and developing hardwood forests typified by wax myrtle, cedar, and cabbage palm.

FOMA has actually increased in size by an estimated 13 acres over the past three decades. This continuing growth is evident in the expanding shoal banks inside and outside the Matanzas River inlet. Shoals inside currently allow fishermen on Rattlesnake Island to wade into the middle of the Matanzas River west of the inlet bridge, while shallow bars outside break Atlantic waves before they can roll into the mouth of the Matanzas River.

Moderate threats to sea turtle nests are due to the high level of vehicular traffic on the beach (it is legally a state highway), and the threat of human poaching of new nests. Beach mouse habitat, a small area (less than 5 acres) is located just behind the first barrier dunes on the beach and is also threatened by overwash from extreme weather conditions accelerated by the vehicular traffic. The park, in cooperation with the State DOT, will be installing two new parking lots and a dune crossover trail all just north of the bridge and improvement of the parking area at the beach access. This project will help reduce the number of vehicles on the beach and provide a hardened interpretive trail that will help keep visitors out of the delicate dune ecosystem. Unfortunately, a separate threat also exists from occasional illegal "dune busting" by 4-wheel drive vehicles.

Minor threats include disturbance of a least tern rookery area by vehicles. In addition, natural plant succession is decreasing the attractiveness of the area as a rookery for the least tern. Foot traffic into the dunes is a constant occurrence, creating blow-outs in the dunes, which reduce their ability to maintain plant life. The dunes directly protect the fort by reducing erosion of the barrier island that shields Fort Matanzas from damaging storms.

Introduced plants pose another minor threat, competing with native species in several disturbed areas of the park. They are beginning to threaten the survival of some species and habitat. Exotic animals such as house cats, both feral and free roaming pets, are a direct threat to the Anastasia Island Beach Mouse. House mice and European rats are considered a potential threat to the Beach mouse and other indigenous mammals.

Chattahoochee River National Recreation Area

On August 15, 1978, Congress passed Public Law 95-344 establishing Chattahoochee River National Recreation Area as a unit of the National Park Service. Congress authorized boundary expansions in 1984 and 1999. The park extends for 48 miles along the Chattahoochee River within the Piedmont Plateau, between the city of Atlanta and the Appalachian Mountains further to the north. The park contains mesic hardwood and pine uplands, scattered cliffs, floodplains, and riparian, aquatic and shoal habitats. The park also contains significant cultural resources, for the river corridor has attracted humans for thousands of years and the remaining features have recorded their passage and story. These natural habitats and cultural resources adjacent to, and partly surrounded by, the growing greater Atlanta metropolitan area, provide a unique opportunity for environmental education and resource-based outreach programs.

The park's entire 48-mile length runs along the Brevard Fault Zone, which forms the Chattahoochee River channel, one of the oldest river channels in the United States. The Brevard Fault is a major 320+ mile long geological feature that, in part, forms the dividing line between two physiographic provinces, the Appalachian Mountains, and the Piedmont Plateau. The steep and rocky Palisades section of the park is generally considered to be the best location along the entire Brevard Fault Zone to view and study this major geologic feature.

The combination of park's mixed habitat types, coupled the old and stable Chattahoochee River channel forming a biological link/corridor with the Appalachian Mountains, has resulted in a high biodiversity within Chattahoochee River National Recreation Area. These diverse habitats support numerous rare and protected aquatic and terrestrial species.

The park constitutes an important outdoor recreation resource to over 3.7 million people located in a major southeastern metropolitan area. The park's green space and the river significantly improve the quality of life by serving as a sanctuary as well as providing a variety of outdoor recreation opportunities such as hiking, nature viewing, paddling, boating and fishing. The Chattahoochee River is inhabited by 22 species of game fish, including the largest stocked trout fishery in Georgia.

At the upstream terminus of the park is Buford Dam, which is operated by the Corps of Engineers. Buford Dam generates electricity and the impoundment, Lake Lanier, provides water to the greater Atlanta metropolitan region. The operation of the dam dramatically alters river flows and water temperatures within the park.

Chattahoochee River NRA (CHAT) consists of 15 separate units, however the park is currently acquiring additional land which will eventually link many of these units. The lands surrounding many of these units, especially closer to Atlanta, are experiencing rapid development and urban sprawl. This urbanization of adjacent lands has resulted in significant river and visual impacts and has taxed the region's sewer utility capacity. As a consequence, heavy rains and storm water runoff routinely cause sewer spills which flow directly into the Chattahoochee River. Additionally, siltation is a consistent problem. Currently there are five permitted commercial sand and gravel mining operations within the park. All utilize suction dredging barges along with an upland dewatering plant.

Although there is a high diversity of native plant species, impacts from exotic species are extensive and pervasive.

Existing baseline data on park resources and impacts are minimal at best. Historically, management has focused primarily upon the park's recreational opportunities. It is only lately that the park has begun to address its long overdue natural and cultural resource stewardship responsibilities. The park has recently begun the development of a long-term water quality monitoring program and is increasing resource staff to address many of the challenges facing Chattahoochee River NRA. Since the park contains a rich assemblage of natural and cultural resources, and is located so close to a large metropolitan region and institutions of higher education, Chattahoochee River NRA provides a great opportunity for resource-based environmental educational outdoor lab "facility".

The park is currently going through the General Management Plan (GMP) planning process. In this document, the stated purpose of Chattahoochee River National Recreation Area is to "lead the preservation and protection of the 48 mile Chattahoochee River corridor from Buford Dam to Peachtree Creek, and its associated natural and cultural resources, for the benefit and enjoyment of the people".

Congaree National Park

Congaree National Park is situated immediately adjacent to the Congaree and Wateree Rivers in southeast Richland County, South Carolina, approximately 20 miles southeast of the capital city of Columbia. The park protects towering old-growth trees and diverse plant and animal life within the largest contiguous bottomland hardwood forest remaining in the United States. Periodic flood waters from the adjacent rivers sweep through the bottomland forest in winter and spring, carrying the nutrients and sediments that nourish and rejuvenate this unique floodplain ecosystem. Nearly 90 species of trees grow within the park, with many that are recognized as national and state champions for their size. Forested wetlands, oxbow lakes, and slow moving creeks and sloughs provide superb habitat for fish, birds, reptiles, mammals and other aquatic life. The diversity of flora and fauna, tall tree canopy and giant trees, and intact floodplain ecosystem earned the park the designation of an International Biosphere Reserve, National Natural Landmark, Globally Important Bird Area, and congressionally designated Wilderness Area.

Congaree National Park encompasses a 26,800-acre bottomland hardwood forest in central South Carolina. Located 20 miles southeast of Columbia, it borders the northeast side of the Congaree River and the west side of the Wateree River. Densely forested, most of the Park is located within the river floodplain. A wide variety of forest communities are represented, with dominant tree species ranging from upland pines to wetland cypress (*Taxodium* spp.) and tupelo (*Nyssa* spp.). The Congaree River forest environment is characterized by silty clay soils, oxbow lakes, swales and sloughs, and meandering creeks. The Congaree and Wateree Rivers are the major source of floodwaters, sediment, and nutrients delivered to the Park, although several tributary creeks also flow through it. The significance of CONG lies in its (1) unique old-growth bottomland hardwood forest community associated with the swamp-like floodplain; (2) remarkably large trees, including loblolly pine, bald cypress (*Taxodium distichum*), tupelo, sweet gum (*Liquidambar styraciflua*), American sycamore, cottonwood (*Populus* spp.), oak (*Quercus* spp.), and holly (*Ilex* spp.) trees; (3) the intact floodplain ecosystem, and (4) high biodiversity. On June 30, 1983 Congaree National Park was designated an International Biosphere Reserve.

Congaree National Park's mission calls for accomplishing the long-term goal of "preserving, protecting, and perpetuating the bottomland hardwood ecosystem in a manner that promotes the natural function of the Congaree River floodplain by (a) managing and restoring designated wilderness areas and all-inclusive wetlands, so as to minimize disturbances to natural landforms, vegetation, and wildlife habitat, and (b) conserving the rich and abundant biodiversity within the Congaree and Wateree River alluvial floodplains by controlling, where necessary, the adverse effects caused by human activities.

Threats to the health and viability of the surface and ground water in the park include: (1) chemical runoff from agricultural fields; (2) an Environmental Protection Agency Superfund Site located five miles from the park northwest boundary; (3) aquaculture operations on the north boundary perimeter; (4) highway treatment residues; and (5) discharges and corporate expansion of two neighboring companies: a nuclear fuel production plant and a pulp and paper manufacturer. Also upstream from the park is the Teepak Company, a manufacturer of synthetic skins for meat products, and the Carolina Eastman Company, a manufacturer of synthetic filament products. The Congaree River receives effluent from many smaller manufacturing plants and from sewage-treatment facilities in

Columbia and adjacent counties. All of these plants are monitored by the State Department of Health and Environmental Control and the State Water Resources Commission. Little, however, is known about their operation or impacts, if any, on park resources.

Exotic species and past land use practices also pose threats to park resources. Although efforts are underway to control populations within the park, feral hog rooting and herbivory causes potentially severe impacts to forest community structure. The past suppression of fire has altered successional processes in parts of the park, while forestry practices have led to the creation of species-poor pine plantations in some areas.

Cumberland Island National Seashore

Cumberland Island National Seashore (CUIS), a 17 ½ mile long sandy barrier island, is one of the larger and more diverse islands on the Atlantic Coast. It totals 36,415 acres of which 16,850 are estuarine. A *Spartina* grass dominated salt-marsh, oyster mud flats and six tidal creeks provide the habitat for a diverse marine-based fauna. The remaining acreage is terrestrial. A live oak -palmetto dominated forest backs an extensive dune system. As the elevation of the island rises on the northwest, a mixed pine-deciduous forest can be encountered. The island is known for nesting loggerhead sea turtles, abundant shore birds, undeveloped dune fields, maritime forest ecosystems, and the historic structures in five historic districts on the National Register of Historic Places. Cumberland Island and its surrounding waters provide habitat for at least thirteen federally listed threatened or endangered species

The National Seashore was established in 1972, to preserve the scenic, scientific, and historical values of the largest and most southerly island off the coast of Georgia. Cumberland Island is also part of the South Atlantic-Carolinian Biosphere Reserve and will be permanently protected in a primitive state. The northern half of the island has also been designated a wilderness area. This unspoiled environment, once prevalent on all the barrier islands, provides a unique opportunity to experience the flora and fauna of a natural coastal ecosystem.

Many of the resource issues at CUIS stem from either external development or past human uses of the island. The southeast Georgia coast is going through profound growth in new, residential communities, many of which incorporate marinas. Recreational pressure will in turn increase on the island, much of it uncontrolled, and the threat to resources and critical habitat will intensify. The dredging and maintenance of the adjacent Intracoastal Waterway and St. Marys Inlet complicate the natural processes of sand budgets and tidal flow, which are key components in the island's stability and ecology. Boat wakes may be contributing to erosion on the back-barrier (west) side of the island. The nearby urban centers of St. Marys, Fernandina Beach, Brunswick, and Jacksonville may contribute to a range of island issues, from air and water quality to light pollution. Regional industries, such as commercial fishing and paper mills, also have an impact on Cumberland Island's resources. Kings Bay Naval Submarine Base is located immediately across the Cumberland Sound from the park.

Past development and human use of the island has significantly changed landscapes and introduced destructive non-native species. Streams and wetlands were altered historically to accommodate agriculture uses. More recently, roads and causeways were constructed which now effect the island's hydrology where they cut across tidal streams, high salt marsh, freshwater sloughs, and wetlands. Non-native species were introduced for ornamental and agricultural purposes but, introductions have been both intentional and accidental. Their presence is significantly degrading the native flora and fauna on the island. Feral hogs present problems in virtually every type of Cumberland Island habitat and, although a management program is in place and the population decreasing, monitoring and actions must be long term. Feral horses also have a serious impact across the island however, their management has been and will continue to be highly complex due to their public popularity. Multiple species of non-native plants have established themselves on the island, with several of the most invasive in dense and/or expanding populations.

Forces driving ecosystem change and diversity are being compromised by current NPS management practices. Without a Fire Management Plan, it is mandatory to suppress all wildfires. Lightning-caused fires are no longer regenerating patchiness and pine forest ecosystems.

Global issues such as sea level rise from increased greenhouse gases in the atmosphere are also important resource issues. Changes in the shoreline and biota from flooding of lower elevations and changes in coastal dynamics may threaten nesting of threatened species and create ecosystem level perturbations.

Fort Frederica National Monument

Established on St. Simon's Island in 1736 to protect South Carolina and Georgia from the Spanish, the town of Frederica was the southernmost post of the British colonies in North America. Today, stately oaks, exceptionally large grapevines, and Spanish moss lend an air of antiquity unequaled on the coast.

The monument is divided by the Frederica River, one of the primary salt marsh rivers in the Brunswick area, with 99 acres of marsh lands at the Frederica site on the west side of the river and approximately 137 acres of uplands adjoining the east side of the river. The Bloody Marsh site consists of 8 acres of which approximately 5 acres are tidal marsh. Approximately 50% of park-owned lands are classified as wetlands.

Outside of the park, the vegetation is composed primarily of pine-hardwood and gum-bay assemblages. Dominant plants include loblolly pines, live oaks, water oaks, saw palmetto, cabbage palms, gums, bays, magnolias and myrtles. A large variety of under brush including several species of ferns and vines is also present. Inside Frederica, clearing and possibly selective cultivation has led to a different variety of plants, especially trees. These include large live oaks, loblolly pines, pecan, magnolia, cedars, sweet gum, and cabbage palm. Large muscadine vines, saw palmetto, and small bamboo are also common. Although the largest part of the marsh is dominated by smooth cord grass, a number of other species are common along the upland boundary. These include black rush, giant cord grass, sea ox-eye, marsh elder, salt myrtle, and *Distichlis*.

Sedimentary deposits composed primarily of sandstone, limestone and clay underlie Frederica. Surface deposits of sand are common to the upland area, while the marsh substrata are composed of unconsolidated clays containing high organic matter content and sand. In most areas the soils are well drained; however, poorly drained soils occur in the northeastern portion of the park.

The climate of the island area and coastal mainland is hot and humid in the summer and cool and wet in the winter with occasional very cold spells. Sub-freezing temperatures are relatively common at night from late November into early February. Spring and fall are marked by heavy concentration of pest insects. The summer months are characterized by frequent, locally severe, thunderstorms with high winds often interrupting commercial electricity.

Specific threats to the resource include:

<u>Water quality</u> deterioration is a concern from industrial pollutants as well as the impact of the intensive recreational use of the Frederica River by boaters and fishermen. The wave action from watercraft presents possible damage to park wetlands and the cultural landscape through erosion by wave action. Several of the nearby industrial plants have buried or discharged, legally and otherwise, toxic wastes in the Brunswick, Georgia, community. This dumping has, in turn, contaminated ground water.

<u>Pest Management:</u> Insect and animal pests at the park present human safety hazards and some natural resource concerns in the form of pine beetle and gypsy moth infestations.

<u>Coastal Dynamics</u>: Any long-term change in coastal dynamics caused by sea level increases would present a clear threat to the Monument's natural and cultural resources. Frederica's elevation is three feet above high tide.

Fort Pulaski National Monument

Fort Pulaski National Monument (FOPU) is located in Chatham County, Georgia along the Savannah River only a few miles from its junction with the Atlantic Ocean. The site consists of two islands that were, before human intervention, primarily salt marsh. Judging from the composition of existing vegetation, Cockspur Island probably supported some coastal hammock forest or woodland. It was selected for fortification as early as the seventeen hundreds. In the eighteen hundreds, as part of the development of the site for defense, the island was modified by the installation of drainage canals and a dike system. In latter years, the site was also impacted by the deposition of spoil material. The addition of dredge material from the Savannah River to Cockspur Island continued until recent times. During the civil war period, the vegetation was removed to enhance visibility and kept in early successional stages. Since the abandonment of the fort in the late eighteen hundreds, a large portion of central Cockspur Island has reverted to maritime forest. Currently the upland portions of Cockspur (approximately 260 acres) support a mosaic of maritime forest, maritime shrub communities, maintained grasslands and successional spoil deposit areas. It also includes over 340 acres of tidal shrubland and tidal herbaceous marsh.

McQueens Island makes up the largest portion of land holdings for the National Monument (about 4,900 acres) and the majority of this consists of salt marsh. A railroad was constructed along the northern edge of the island in 1887 to connect the city of Savannah with Tybee Island and operated until 1933. In 1923, US Highway 80 was constructed, occupying a location across the central portion of the island and adjacent the old railroad grade along the eastern section. In 1994 Chatham County converted the abandoned railroad right-of-way to a multipurpose hiking trail. Both the highway and the converted rails-to-trails areas support ruderal habitat for a number of coastal plain herbaceous species. Other upland habitat on McQueens Island occurs in association with a public fishing and boat ramp on the eastern end of the island and an abandoned section of US 80 leading to the Bull River.

The natural resources at FOPU face a number of threats, primarily related to its proximity to the city of Savannah. Heavy industrial development on the Savannah River, as far upstream as the Savannah River Site near Aiken, SC, have been known to impact the water quality and ecological health in and around the park. Pollutant levels in water, sediment, and invertebrate tissue will be analyzed as part of an upcoming study. Shipping traffic and associated dredging are contributing to increased shoreline erosion along the north shore of Cockspur Island. Finally, Highway 80 between Savannah and Tybee Island is slated for widening in the near future, impacting park wetlands adjacent to the existing roadway. The Monument is currently working with the U.S. Fish and Wildlife Service, the Federal Highways Administration, and the Georgia Department of Transportation to develop a mitigation plan that complies with NPS Wetlands Policies.

Fort Sumter National Monument

Fort Sumter National Monument (FOSU) consists of 200 acres of land located at the mouth of Charleston harbor and on nearby Sullivan's Island, South Carolina. The park's two major features are Fort Sumter, site of the Civil War's first engagement, and the somewhat older Fort Moultrie.

Historic Fort Sumter is influenced dramatically by the surrounding natural elements. Of the 198 acres that comprise the park, 122 acres surrounding the Fort are submerged under the waters of Charleston Harbor. The remaining acreage is located on Sullivan's Island and in Charleston. Adjacent to the park, but outside its boundaries, are shoals, islands, and marshes important to the Fort Sumter scene. Two endangered species, the manatee and the loggerhead turtle, migrate through the waters adjacent to the park, but do not live or nest within the park itself.

The 28-acre Charles Pinckney National Historic Site (CHPI) was established under Public Law 100-421 and is a relatively new addition to the National Park Service. It is a rural vernacular landscape in use from 1695 until the 1980's, and was actually a working farm until the 1960's when nearly 700 acres were sold for development. The grounds include three acres of wetlands, eight acres in mixed hardwoods and pines, and ten acres of open pasture. The site, which fronts Long Point Road, a scenic highway, is surrounded by suburban housing developments.

A Servicewide issue potentially threatening Fort Sumter is sea level rise. At present, sea level rise is approximately 1.3 millimeters per year, but many experts believe this rate may accelerate in coming decades. An annual increase in sea level, no matter how small, over a long period of time would upset coastal dynamics in the Charleston area and could eventually pose a direct threat to Fort Sumter and Fort Moultrie.

Harbor dredging is another major concern. Dredging is necessary in order to maintain Charleston as a viable seaport; however, it negatively impacts Fort Sumter's marine ecosystems as well as disturbing the historic viewshed by creating spoil banks on nearby barrier islands. The park staff continues to monitor dredging activities within the harbor, working with the Army Corps of Engineers and local authorities to mitigate the impact of dredging on the historic scene whenever possible.

Insect infestations present a natural resource management concern. Fire ants, termites, and other insects are unsightly to the visitor and can be harmful. As in the case of fire ants, they may bite visitors creating painful welts. The park's approved Integrated Pest Management Plan requires revision to incorporate the new facilities of Charles Pinckney NHS, Moores Creek NB and the Curatorial Storage Facility.

Horseshoe Bend National Military Park

Horseshoe Bend National Military Park (HOBE) is comprised of 2,040 acres. The park is situated near the southern end of the Piedmont Plateau. It contains low rolling hills, which reach elevations from 600 feet to 711 feet above sea level. The park not only contains many species of plants endemic to the Piedmont region, but also species associated with the Southeastern and Southern Coastal Plains. River bottomland borders each side of the Tallapoosa River. This land, which was extensively cultivated from 1832 until the establishment of the park in 1959, is in various stages of ecological succession.

The land has undergone some minor changes in the intervening 175 years since the battle. In many places pines have displaced the climax hardwoods that existed in 1814. The vegetation has been altered by human settlement, logging, and by the introduction of exotic species. The timbered lands that once gave way to agricultural crops have now given way to natural reforestation or open fields. "Forest type is mesic beech-oak-hickory with some loblolly pine. Drier areas and ridge tops are dominated by loblolly pine. The understory is relatively open and dominated by sapling elms, blueberries, silver bells, muscadines and ferns." The condition of wildlife species was basically unknown upon acquisition of the park. It was found that all wildlife species had been indiscriminately hunted and preyed upon by feral dogs and cats until many species barely continued to exist. Enforcement of resource laws concerning flora and fauna has allowed a diversity of wildlife species to be re-established upon the varied habitats of the park.

The hydrologic regime of the Tallapoosa River, three and one-half (3 ½) miles of which are within the park boundary, is dam-controlled upstream of the Park by Alabama Power Company. The release schedule is determined by hydroelectric needs and bears no relationship to natural flows, more resembling a "trickle or torrent" that impacts both natural resources and the cultural landscape. The U.S. Fish and Wildlife Service is currently seeking to accelerate reauthorization of the dam in order to negotiate a flow regime less detrimental to river ecology.

Pine forests at HOBE have been impacted heavily in recent years. Southern Pine Beetle infestations are growing and rapidly spreading in many areas of the park. In some cases infestations are moving toward park boundaries and endangering private lands. A heavy accumulation of slash and downed trees due to beetle kills and the aftermath of Hurricane Opal have resulted in potentially dangerous fire situations. Ladder fuels, heavy pine needle litter, and duff accumulation could substantially increase the difficulty of controlling wildfires. Ladder fuels, such as honeysuckle and other vines would assist a hot ground fire into a crowning fire.

Exotic species have impacted some areas within the park. Invading exotic plants such as Ailanthus (*Altissima*), Mimosa (*Albizia julibrissin*), Chinaberry (*Melia azedarach*), Japanese Honeysuckle (*Lonicera japonica*), Kudzu (*Pueraria lobata*), and Sandburs (*Cenchrus longispinas*) continue to expand and invade new areas.

Kennesaw Mountain National Battlefield Park

Kennesaw Mountain National Battlefield Park (KEMO) was created to commemorate the 1864 Atlanta Campaign of the Civil War. In particular it preserves the battle lines where from mid-June to early July the Confederate forces under Joseph E. Johnson delayed the advance of William T. Sherman's Union forces in their advance from Chattanooga to Atlanta. The Park's Enabling Legislation is included in Appendix 2.

The natural resources of the 2,884-acre park include the 1,808-foot peak of Kennesaw Mountain, Little Kennesaw Mountain and hundreds of acres of mixed hardwood/pine forests intermixed with a number of grassy fields. Included are over 16 miles of designated hiking trails that attract hundreds of recreational visitors daily. The Park's location in the Atlanta metropolitan area makes it the second most visited battlefield in the National Park System and has earned it a position on the Secretary of Interior's list of twenty-five most threatened parks.

Largely because of its proximity to Atlanta, major natural resource threats exist at KEMO. The development of Cobb County and greater metro Atlanta makes the lands within Kennesaw Mountain relatively valuable for natural habitats of localized plant and animal communities. Cobb County has plans to expand roads and highways that traverse the park and pose a potential threat to both cultural and natural resources. In addition, there are minor threats from encroachment of adjacent landowners, exotic plant species, and industrial air and water pollution. Since 1993 a pine beetle infestation has killed off thousands of pine trees throughout the park and the resulting increase in fuels laying on the forest floor pose an increased fire risk. Natural succession to hardwood forest is expected. There appears to be an increase in the beaver population. As the beavers create their dams, distribution and water quality is altered. The mitigation of encroachments and the removal of exotic plants are ongoing programs. A formal water-monitoring program is on-going and collected data indicates an extremely high fecal coliform level.

Moores Creek National Battlefield

Moores Creek NB is located in an area of second growth forest interspersed with small farms. Local woodlands are harvested for the pulp industry. Presently, no significant industrial, commercial, or residential developments exist near the park. The topography of the region is relatively flat. A short distance within the park, the higher land characteristic of the inland Carolina coastal plain descends abruptly to the lowlands that comprise the greater portion of the park land, reaching to Moores Creek. This freshwater stream, averaging 30 feet in width, forms the western boundary of the park. Bordering the park are screens of dense second-growth vegetation, while the landscape at the center of the development consists of grass-covered meadows and slopes with scattered trees and brush. Habitats: alluvial woods, old fields, ditches, sandy xeric woods, lawns, a pond, pinewoods, mixed wooded slopes, creek banks, roadside ditches and meadows.

Several potential threats to MOCR resources have been noted. Although the park is fairly isolated, residential development on adjacent lands has been increasing in recent years. Past landscape practices at the Battlefield have likely impacted several locally rare and/or state-listed plant species. Efforts to restore habitat for these species is currently underway, although long-term monitoring is necessary to fine-tune efforts and ensure their eventual success. Finally, the predominant tree species, loblolly pine, is greatly affected by pine bark beetle. Long-term efforts are underway to restore the beetle-resistant, native Longleaf pine across much of the Battlefield.

Ocmulgee National Monument

Ocmulgee National Monument (OCMU) sits on the “Fall line,” the transition between the rolling Piedmont and the flat Atlantic Coastal Plain. A portion of the monument is within the city limits of Macon, GA. The Ocmulgee River comprises the boundary on one side of the monument. Ocmulgee National Monument preserves the history of the people of the Southeast; artifacts have been found dating back 10,000 years. The visible features are mounds, built by the Mississippians who lived here from approximately 900-1100 AD.

The natural resources of the park have been heavily impacted by human activities, including I-16 and its associated berm, which has essentially cut off the river from its floodplain and disrupted the natural flow of the area. Despite this, and its proximity to Macon, Ocmulgee has a surprising amount of wildlife present. This is probably a result of a corridor, or what is known locally as the “Greenway,” connecting the monument to other natural areas south of the monument. Numerous bird species are present in the monument, either feeding or nesting or both. Migratory birds utilize the area as a stopover during spring and fall migrations. The endangered wood stork (*Mycteria americana*) feeds here during summer months. Numerous other wildlife live here, including deer, beaver, bobcat, alligators, and various reptiles and amphibians. Recreational fishing is allowed, with largemouth bass and bream being two common catches. Within the last eight years, coyotes have entered the monument. What effect this will have is unknown. Exotic species include nutria, fire ants, feral pigs, as well as domestic dogs and cats. Vegetative exotics include privet, Japanese honeysuckle, and kudzu.

The overall lack of knowledge of the natural resources in the monument has become both a problem and a frustration. Major changes have occurred, such as a 500-year flood associated with Tropical Storm Alberto in 1994, pressure from exotic species, particularly feral pig damage, as well as more subtle changes over time. Since there is no baseline data for the monument, there has been no way to track these changes or impacts over time.

Threats affecting the native plants and animals in the monument result mainly from human activities, and include exotic species, water quality, air quality, development, and the general proximity to the city of Macon. Exotic species are a disruptive influence in the monument. Disruptive and invasive species include privet, Japanese honeysuckle, and feral hogs. Within the last year, feral pigs are responsible for a tremendous amount of resource damage in both the main unit and the detached Lamar unit. Fire ants are spreading through the park.

Human occupation has severely impacted the park. A railroad and I-16 bisect the park; a sewage lift station and its associated underground pipes are in the park. A once small stream now drains a large part of east Macon, bringing large amounts of trash, pollution, and occasionally raw sewage into the park. This has raised questions regarding water quality, groundwater quality, and where the pollution goes. The city of Macon is also close to failing air quality standards; what will result from this remains to be seen. Development around the monument is a threat as well; development within the corridor could cut off the monument, leaving the existing populations isolated fragments.

Timucuan Ecological and Historic Preserve

Situated entirely within Duval County and the city limits of Jacksonville, FL, Timucuan Ecological and Historic Preserve encompasses approximately 46,000 acres between the St. Johns and Nassau rivers. The southern third of the Preserve lies at the mouth of the extensive St. Johns River watershed, which includes parts of Duval and several other counties for approximately 300 miles to the south. The St. Johns River is heavily impacted by agricultural, industrial and urban pollution; however, marine tidal waters near its mouth serve to ameliorate pollution through dilution and flushing. Water quality is considered relatively good in the Preserve due to this flushing action. The northern two thirds of the Preserve lies within the Nassau River drainage basin, a small watershed that covers parts of Duval and Nassau counties. The Nassau River watershed has not yet experienced the concentrated urban and industrial growth found along the St. Johns River; still, portions of the watershed exhibit poor water quality. The area surrounding the Preserve to the west and north is predominantly marsh and low uplands utilized for timbering, residential and agricultural uses.

Several rare, threatened or endangered species are known to use the Preserve, including the West Indian Manatee (*Trichechus manatus*), Colonial Wood Stork (*Mycteria americana*), Least Tern (*Sterna antillarum*), Gopher Tortoise (*Gopherus polyphemus*), Arctic Peregrine Falcon (*Falco peregrinus*), and Loggerhead Sea Turtle (*Caretta caretta*). Other rare, threatened or endangered species are suspected to occur within the Preserve, such as the Eastern Indigo Snake (*Drymarchon corais couperi*) and Atlantic Sturgeon (*Acipenser oxyrhynchus*).

Timucuan and Fort Caroline National Memorial are administered as one park. Fort Caroline NM includes approximately 138 acres located along the St. Johns River within the city of Jacksonville and Duval County, Florida. Located primarily on a bluff overlooking the river that rises to a height of nearly 90 feet, the park consists of mixed species forest with fresh water wetlands, preserving an enclave of representative species native to the North Florida-South Georgia community.

Duval is one of the fastest growing counties in Florida. The Preserve is located in an area that has historically experienced limited development and growth due to lack of easy and quick access. Development and recreational use pressures have increased, however, with the opening of a six-lane bridge in 1989 and ongoing construction of a major highway linking the bridge to the interstate highway system.

Throughout both watersheds, many residential homes operate private well and septic systems, the failure of which is a presently unquantified source of water pollution. An unknown amount of pesticide, herbicide, and fertilizers is transported by stormwater runoff to the marshes of the Preserve. Contaminated sediments are known to occur in some areas of the Preserve, but the extent of contamination and the effects of sediments resuspension are not known. This is of particular concern as several major dredging projects are proposed in the near future.

Exotic plants and animals are known to occur within the Preserve, but information on species, locations and potential threats is lacking. The Preserve presently has little information on vegetative and aquatic habitats, ecological processes, and current ecological conditions. Related to the issue of exotic species is the recent development of a prescriptive fire program, which is expected to be instrumental in returning native species to the numerous pine plantations within the Preserve.

Water Resources of the Southeast Coast Network

Water Bodies

Eight percent (23/274) of water resources within or adjacent to SECN Parks are 303(d)-listed waters, with 39% (9/23) of those occurring at CHAT (See Appendix 8 for more details). 303(d)-designated waters are considered to be relevant to park managers if (a) they pass through, enter or are contained within Park boundaries as EPA-designated 303(d) waters or (b) they are designated 303(d) waters within the same 12- or 14-digit HUC boundaries as each respective Park. Twelve-digit HUC coverages were available for AL (i.e., in draft form), FL and GA; 14-digit HUC coverages were available for NC and SC. All 303(d) designations are based on the most recent (2002) EPA and state listings of impaired waters and GIS coverages (http://www.epa.gov/waters/data/downloads.html).

Various GIS coverages [e.g., Digital Raster Graphics, National Hydrography Dataset, EPA 303(d) listed waters] and existing Park narratives were reviewed for all available information regarding documented SECN Park water bodies. Special designations of Park waters were also noted (Appendix 8, Tables A8-1- A8-9). CHPI, FOCA and WRBR have no documented water resources within Park boundaries.

Water Quality

Despite the Federal Water Pollution Control Act of 1956, subsequent amendments in 1972, the Federal Water Pollution Control Act of 1972, the Clean Water Act of 1977 and the Safe Drinking Water Act of 1977, the chemical, biological and physical integrity of the nation's waters remains threatened (Hermann et al. 1998). Compromised water quality is largely the result of management of chemical, biological and physical discharge/waste from urbanization/population growth and agricultural and industrial activities. Adverse effects of impeded water quality on biota include altered floral- and faunal- species composition, reduced fecundity, low fitness, and bioaccumulation. The Southeastern U.S. is one of the fastest growing areas in the nation; consequently, marine and freshwater water quality throughout Southeast Region Parks has been impacted (White et al. 1998). Despite the abundance of 303(d)-listed waters in the Southeast Region, only ten percent of SECN water resources are 303(d) listed. However, most of the SECN parks are downstream from multiple 303(d) listed waters outside NPS jurisdiction (Figure 1-1).

Water quality data in most SECN Parks, and adjacent lands, have been collected by a variety of governmental and private entities. Existing data were compiled and summarized by the Inventory and Monitoring Program and Water Resources Division of the USDI National Park Service (NPS) and Horizon Systems Corporation (HSC) into documents referred to as the Horizon Reports (National Park Service 1994a, National Park Service 1994b, National Park Service 1994c, National Park Service 1994d, National Park Service 1994e, National Park Service 1994f, National Park Service 1997, National Park Service 1998a, National Park Service 1998b, National Park Service 2001, National Park Service 2002a, National Park Service 2002b). Although the Horizon Reports provide a very thorough summary of baseline water quality data in SECN Parks, the data compiled and summarized for this endeavor included data only as recently as 1990 and 1992 for FOFR and CAHA, respectively, or 1998 for FOMA, FOPU, and FOSU (Appendix 8, Table A8-10). As a result, recent trends in water quality are unknown. The SECN Inventory and Monitoring team is currently acquiring these data to establish recent trends in water quality at SECN Parks.

Thoroughness of water quality data varies from park to park, however data are adequate to establish trends in waterbodies adjacent to parks, and infer status in parks if data within park boundaries are limited, if not the parks themselves. However, gaps in the datasets, in terms of evaluations of all significant water resources in each park, do exist (e.g., no water-quality sampling has occurred on two freshwater ponds at FOPU that account for 67% of freshwater resources at the park) and attempts to rectify these issues will be incorporated into future water-quality sampling designs. Because many agencies, organizations and individuals have contributed to existing long-term water-quality data (in regard to data collection and laboratory analyses), estimates of data accuracy, precision, and subsequent reliability, are currently unknown.

Results from the Horizon reports were qualitatively summarized in order to determine potential “red flags”, or parameters that consistently exceed established water quality criteria, in SECN park water resources and assist in determining focal points (i.e., water-quality parameters) for future water-quality sampling design (Appendix 8, Table A8-11). Total Coliform measurements commonly exceeded EPA standards in SECN parks, although Fecal Coliform, several forms of which are naturally occurring, was not consistently differentiated from Total Coliform. Although no other “red flags” are evident in existing Network-wide data, Chloride and Copper levels exceeded EPA standards in several Parks, which can cause gastrointestinal irritation and kidney and liver damage, respectively, in humans. Current EPA guidelines for select water quality parameters are also presented (Appendix 8, Tables A8-12 through A8-14).

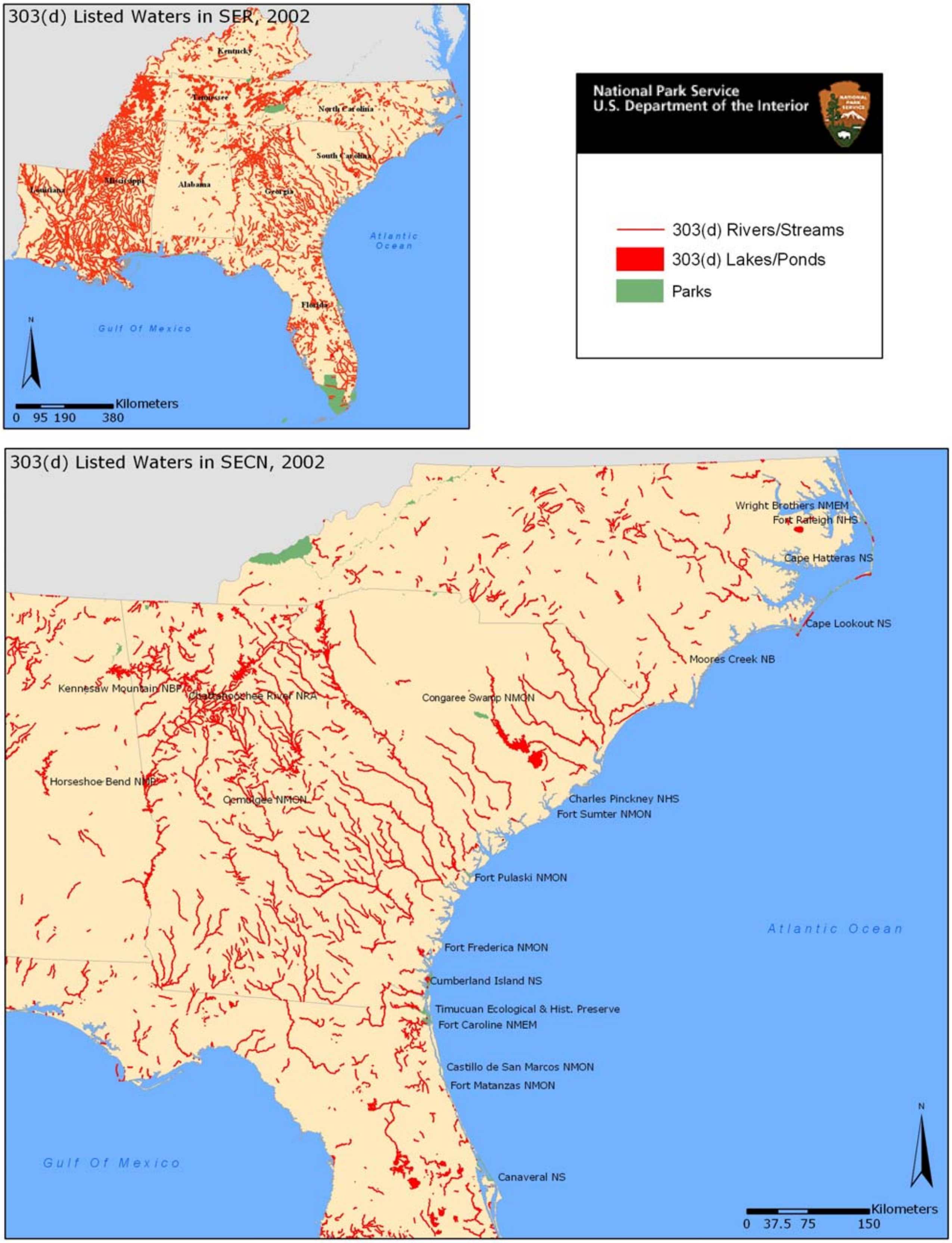


Figure 1-1. 303(d) waters in SER and SECN, 2002.

Air Resources of the Southeast Coast Network

None of the Southeast Coast Network parks are within Class I airsheds. However, air quality is of concern at several parks within the network due to ozone exposure and atmospheric deposition of metals and nutrients (Table 1-3). Four parks within the network (CHAT, KEMO, HOBE, and OCMU) are in areas where vegetation is at a high risk of damage due to ozone exposure. Park water quality data were reviewed for fifteen Southeast Coast Network parks; surface waters at CONG and MOCR are extremely sensitive to acidification from atmospheric deposition. Elevated concentrations of metals in surface waters indicate that atmospheric deposition of metals might be an issue for half of he Southeast Coast Network parks.

Table 1-3. Summary of air quality issues in Southeast Coast Network Parks. ["↑", Increasing; "↓", Decreasing; "NT", No Trend; "Y", Yes; "N", No; "○", Frequent or consistently surpasses air quality thresholds; "○", surpasses or infrequently surpasses air quality thresholds; "-", either does not surpass air quality thresholds or no data are available; "L", Low; "M", Medium; "H", High].

		CAHA	CANA	CALO	CASA / FOMA	CHAT	CONG	CUIS	FOFR	FOPU	FOSU / CHPI	HOBE	KEMO	MOCR	OCMU	TIMU / FOCA
Wet Deposition																
Ammonium	Deposition		↑		NT		↑					NT		↑	NT	NT
	Concentration		↑		NT		↑					↑		↑	NT	NT
Nitrate	Deposition		↑		NT							↑		NT	NT	NT
	Concentration		↑		NT							↑		NT	NT	NT
Sulfate	Deposition		NT		↓							↓		↓	↑	↓
	Concentration		NT		↓							↓		↓	↑	↓
Dry Deposition																
Nitrogen	Overall dry deposition			NT								NT		NT	↑	
	Percentage of total N that is dry			32								36		37	42	
Sulfur	Overall dry deposition			NT								↓		NT	↓	
	Percentage of total S that is dry			36								41		34	42	
Surface Water Chemistry																
Acidification	Concern for Park	N	N	N	N		Y	N	N	N		N	N	Y	N	N
Metals	Potential aerial deposition						Y			Y		Y	Y	Y	Y	Y
Nutrients	Potential aerial deposition	N	N	N	N		N	N	N	N		N	N	N	n	N
Ozone																
Sum06	Frequency standard surpassed	●	○	●	●	●	○	○	○	○	○	●	●	●	●	○
W126	Frequency standard surpassed	○	-	○	-	●	○	-	-	-	-	●	●	○	●	-
Foliar Injury	Risk based on conditions	M	L	M	M/L	H	L	L	L	L	L	H	H	M	H	L

Analysis of SECN Natural Resource Issues

Monitoring program-related issues of highest importance to parks in the Southeast Coast Network fall into seven broad categories: exotic plant management & control, water quality, geology & geomorphology, water quantity, fire management, habitat management, and species management. Detailed descriptions of park natural resource issues and relative monitoring priorities for each park can be found in Appendix 5 and Appendix 9.

Exotic Plant Management and Control. Monitoring questions related to exotic plant management were the only questions consistently of high priority across all parks within the Southeast Coast Network. Currently only parks within Florida are included in an operation exotic plant management program: Canaveral National Seashore (CANA), Timucuan Ecological & Historic Preserve (TIMU), Fort Caroline National Monument (FOCA), Castillo de San Marcos National Monument (CASA), and Fort Matanzas National Monument (FOMA). Beginning in FY 2005, the remaining parks within the network will be included in a three-year pilot program to identify and remove exotic plant species. Monitoring needs related to identification of sites of existing exotic plants and tracking the success of management actions will be critical for the long-term success of this program.

Water Quality. In general, questions relating to water quality were high across all parks also, but the water bodies among the park vary substantially across the Network.

- Estuarine / Lagoonal. Nine parks within the network contain significant estuarine or marine waters: Cape Hatteras National Seashore (CAHA), Cape Lookout National Seashore (CALO), Fort Sumter National Monument (FOSU), Fort Pulaski National Monument (FOPU), Fort Frederica National Monument (FOFR), Cumberland Island National Seashore (CUIS), TIMU, FOMA, and CANA. Mosquito Lagoon at CANA is another significant brackish water body. Water quality in these systems is almost entirely driven by upstream or up-shore factors outside National Park Service boundaries or jurisdiction, and water quality monitoring is in general conduced by the various coastal states. Currently University of North Carolina at Wilmington, The University of Georgia, and The University of Florida are investigating watershed / landscape level influences of estuarine water quality at CAHA, CALO, FOPU, CUIS, TIMU, and CANA.

- Coastal. Six parks (CAHA, CALO, CUIS, TIMU, FOMA, and CANA) contain significant areas with access to marine / ocean waters. In all cases except CANA, NPS jurisdiction extends only to mean high tide; CANA's jurisdiction extends ½ mile east of the shore line. Threats to coastal water quality include non-point source chemical contaminants from up-shore as well as marine debris.

- Riverine. Six parks within the network contain or are bordered by significant river systems ranging from upland to coastal plain drainages: Chattahoochee River National Recreation Area (CHAT), Kennesaw Mountain National Battlefield Park (KEMO), Horseshoe Bend National Military Park (HOBE), Ocmulgee National Monument (OCMU), Congaree National Park (CONG), and Moores Creek National Battlefield (MOCR). With the exception of the rivers contained within CONG, all other parks contain limited portions of the watersheds that the rivers drain. Adjacent land use and upstream development pressures are consistent threats to water quality among the river parks, but the types of land use and development pressures range widely from agriculture / animal husbandry operations, to extremely dense urban and suburban landscapes.

Geology and Geomorphology. Parks within the network are all in highly dynamic coastal or riverine ecosystems. Although changes in the landscape are a natural part of the evolution of the landscape, the degree to which observed processes can be considered "normal" are largely unknown. Coastal barrier islands and river systems are the two predominant systems with high rates of geomorphic change.

- Coastal Geomorphology. All coastal parks are experiencing geomorphic changes either through accretion or erosion. Though these processes are natural in barrier island ecosystems, the current rates and locations of accretional and erosional zones are likely outside natural norms. Non-natural factors that are suspected to influence erosion and deposition rates include dredging operations, jetty and pier construction / placement, and hardening of shorelines.

- Stream Bank Erosion. Stream bank erosion and stability is a major concern at CHAT, HOBE, KEMO, and OCMU where hydrologic modification resulting from upstream watershed development and hydropower facility management has resulted in altered riverine flow regimes.

Water Quantity. Water quantity issues in general are currently of concern, but will likely become larger during the next 10-20 years as water demands in the Southeast increase.

- Surficial. River systems provide the majority of drinking water for the southeast. Major water supply reservoirs are located upstream of HOBE, CHAT, OCMU, and CONG, that serve the areas of Montgomery, AL, Atlanta, GA, Macon, GA, and Columbia, SC respectively. The amount of fresh water that reaches estuarine systems is likely one of the major drivers that influences estuarine and salt marsh ecosystem health.
- Groundwater. The Floridan aquifer is the main water supply source for agricultural and industrial needs along the southeast coast. The degree to which withdrawals affect park resources is not known, but as demand increases, the potential for impacts on park ecosystems could increase.
- Effects of hydrologic modification. In addition to the average amount of water available within parks, the timing and distribution of flooding events is also changing due to upstream or watershed land use activities. In general flooding frequency of major floods has decreased during the last twenty years, and hydropower "peaking" operations have introduced a flow regime in riverine ecosystems that is outside expectations in natural systems. Multiple other water diversion structures occur in or near parks for agricultural, pest control, or transportation purposes.

Fire Management (effects, risks, and planning). Twelve of the network parks currently have or are in the process of developing fire management programs. The activities that will be conducted at each park will vary widely from suppression to routine prescribed burning. In all cases, climatic data relating to fire risk will be useful for fire management planning and risk assessment. Programs implementing prescribed burning would benefit from fire effects monitoring.

High Priority Ecosystems & Habitats. The Southeast Coast Network contains multiple habitat types. The following four systems / habitats had the most commonality among Network parks.

- Rivers. In addition to the six parks that contain large rivers, CAHA and CUIS contain smaller freshwater systems.
- Coastal Dunes. Coastal dunes are major habitat features at CAHA, CALO, CUIS, and CANA. Future land acquisitions at TIMU might result in the addition of dune habitats there as well. Coastal dunes are particularly important due to the fact that (a) they support a wide variety of sensitive or protected species, (b) they are fragile, (c) they are particularly threatened by visitor uses, and (d) they play a significant role in the overall stability of the island..
- Wetlands. Wetlands within SECN parks vary widely from intermittent interdunal pools to riparian floodplains to vast salt marshes. These systems are particularly sensitive to changes in water quantity.
- Intertidal zones. Intertidal zones, provide critical foraging and nesting habitats for many sensitive and protected species such as shorebirds and sea turtles. These areas are threatened by visitor uses, and predation from both native and non-native species.

Threatened, Endangered, and other Species of Management Concern. More than twenty species were identified for potential monitoring across the Network, though with very few exceptions, those needs were only relevant at 1-2 parks due to limited species' ranges. In general, species-specific monitoring questions had the largest difference between overall average scores and adjusted average scores. In nearly all cases, floral and faunal differences among parks were large enough that few species' ranges span more than three parks. Exceptions include shorebirds, marine turtles, and multiple exotic plant and animal species. The following include species whose distribution occurs across six or more parks *or* whose impacts are large.

- Feral Hogs. Eight parks in the network have current, historic, or potential infestations of feral hogs: CAHA, CANA, CASA, CONG, CUIS, FOFR, OCMU, TIMU. Active eradication programs are occurring at OCMU, and CUIS.
- Shorebirds. Plovers, oyster catchers, least terns, and wood storks are of large concern at all coastal beach parks. Active monitoring occurs at CANA, CUIS, CAHA, CASA, and CALO, those these

efforts are not currently coordinated.

- Marine turtles. Marine turtles are monitored and protected at seven Network parks (CAHA, CALO, CANA, CASA, CUIS, FOPU, and FOSU). These monitoring programs are currently coordinated with other state and federal agencies though not with one another. In addition to turtle monitoring, other related monitoring needs include predator, beach habitat, and light pollution monitoring.
- Feral Horses. Feral horses are present at CUIS, CALO, and CAHA. In addition to the need to monitor aspects of horse populations (i.e., demography, disease incidence rates), the effects of the horses on other park resources.

Summary of Existing Monitoring Programs

At least 140 historical or ongoing monitoring programs are being conducted by various agencies within the Network (Table 1-4; Appendix 3). Only 34 of those are being conducted by the NPS. However, more than 100 historical and on-going monitoring programs are being conducted in or adjacent to Network parks by other State, Federal, or County agencies or one of many NGOs. The majority of NPS programs have centered on threatened and endangered species monitoring, primarily with reptiles and birds. Non-NPS monitoring programs span a wide variety of categories, but nearly a quarter of those programs deal with water resources monitoring.

Table 1-4. Existing and historical monitoring programs relevant to Southeast Coast Network parks. For a detailed description of programs, objectives, and the types of monitoring data being collected, see Appendix 3.

Category	NPS programs	Non-NPS programs	Total
Water Resources	1	24	25
Air Resources	3	5	8
Climate & Weather	0	5	5
Ecosystem Processes	1	2	3
Pest Species	0	3	3
Exotics – Invertebrates	1	3	4
Exotics – Vertebrates	1	1	2
Exotics – Plants	1	4	5
Forestry	0	4	4
Geology	1	5	6
Marine / Estuarine Systems	1	12	13
Recreational Use	0	2	2
Threatened & Endangered Species	0[1]	10	10
Vegetation	5	7	12
Vertebrate Disease	0	3	3
Waste Management	0	1	1
Wetlands	0	1	1
Wildlife – Birds	8	8	16
Wildlife - Fish	0	3	3
Wildlife – Mammals	4	1	5
Wildlife – Reptiles & Amphibians	7	2	9
Total	**34**	**106**	**140**

[1]*Several NPS T&E species monitoring programs are included in the "wildlife" categories below*

2. Conceptual Ecological Models

Modeling Framework

Development of conceptual models is a required step in design of the Vital Signs Monitoring Program for each network. This requirement is based on lessons learned about monitoring program design from the NPS experience with its prototype parks program, and from many other monitoring programs. What these lessons demonstrate is that every monitoring effort is based on some underlying understanding of how the ecosystem in question works. This underlying understanding forms a mental model, often not written for others to read and discuss. To ensure a successful monitoring effort, these underlying models need to be explicit and available for discussion, evaluation, and refinement (Maddox et al. 1999).

Models are purposeful representations of reality (Starfield et al. 1994). Conceptual models provide a mental picture of how something works, with the purpose of communicating that explanation to others. Models (of all types) work best when they include only the minimum amount of information needed to meet the model's purpose (Starfield 1997).

Conceptual models play several useful roles in monitoring program design, including:

- Formalizing current understanding of the context and scope of the ecological processes important in the area of interest;
- Expanding our consideration across traditional discipline boundaries, fostering integration of biotic and abiotic information;
- Facilitating communication among scientists from different disciplines, between scientists and managers, and between managers and the public.

The primary natural ecosystems within the network are terrestrial, riverine, and nearshore marine / estuarine, each of which can be defined by a combination of expected and observed characteristics of disturbance regimes, surrounding landscapes, hydrology, succession, habitats, and biota. In all systems, the goal of the modeling is to look at the ecosystems at multiple hierarchical levels: the overall generalized ecosystem, the processes that occur and define the status of resources within sub-ecosystems, and the key components and linkages that make up those ecosystems. Only the generalized and process models are considered here. Detailed descriptions of model components can be found in Appendix 7.

Generalized Ecosystem

An ecosystem conceptual model can be considered as a list of state variables and forcing functions of importance to the ecosystem and the problem in focus. General ecosystem models also show how these components are connected through ecosystem processes (Jorgensen 1986). Allen and Hoekstra (1992) emphasize that "we do not wish to show that everything is connected, but rather to show the minimal number of connections that we can measure may be used as a surrogate for the whole system in a predictive model." An important step in model construction is to identify an appropriate level of resolution given the model objectives (Starfield and Bleloch 1986). Processes that occur much more slowly than the system of interest may be aggregated and considered as constraints of the system; processes that occur more rapidly than the system of interest may be aggregated and considered as 'noise' (Turner and O'Neill 1994).

Purposes of the general ecosystem characterization models include:

- To indicate the driving abiotic factors that constrain the system, depict their relationships to key structural components and processes, and describe resultant ecosystem characteristics.

- To describe the predominant natural disturbances that historically influenced the system, indicate their relative importance in structuring the system, and summarize ecosystem-specific disturbance patterns (return intervals, extent, magnitude, seasonality).
- To characterize the prevalent anthropogenic stressors that are currently affecting the system, describe their relationships to key structural components and processes, and describe resultant ecosystem effects.
- To provide a foundation for evaluating the range of current conditions of key structural components within the context of historic natural variability.

Ecosystems in the Southeast Coast Network can be characterized by "natural" ecosystems that are faced with a combination of biotic and abiotic (both natural and anthropogenic) external agents of change (Figure 2-2).

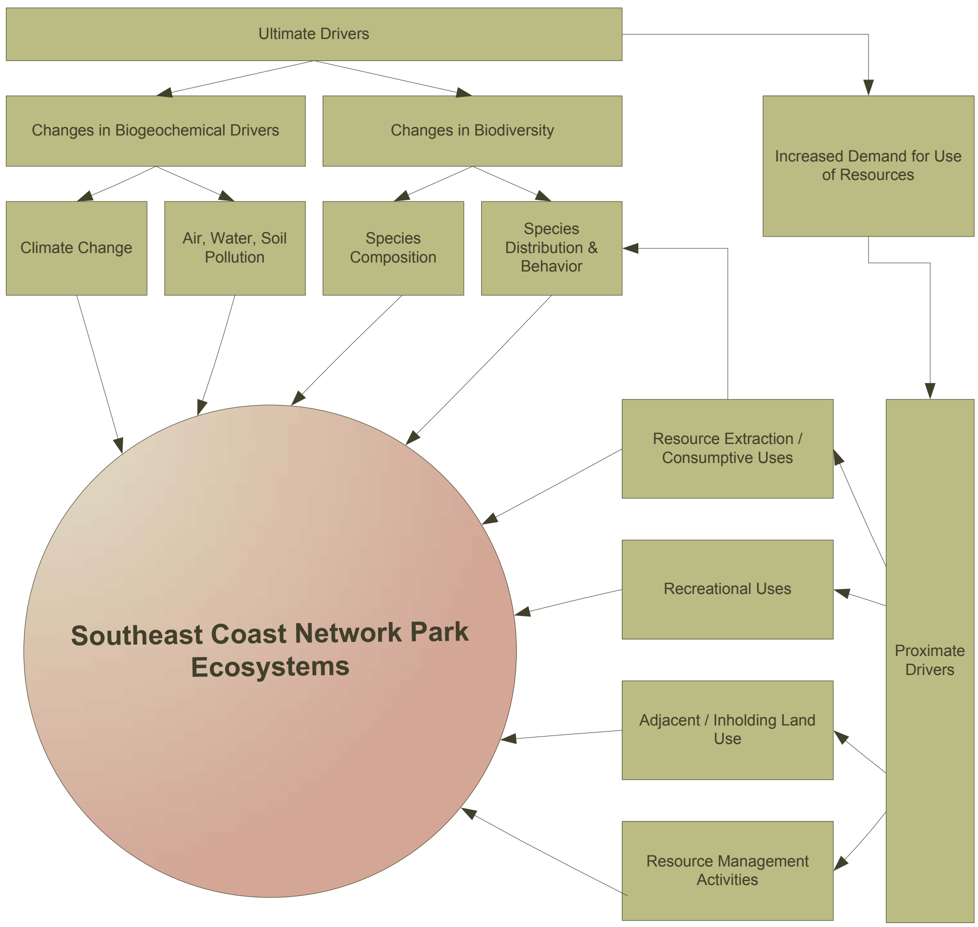


Figure 2-2. Generalized model of primary drivers that affect Southeast Coast Network ecosystems.

Dynamics of Ecosystems

Three of the five servicewide goals for vital-signs monitoring are oriented towards the *dynamics* of ecosystems or selected ecosystem components:

- Determine status and trends in selected indicators of the condition of park ecosystems to allow managers to make better-informed decisions and to work more effectively with other agencies and individuals for the benefit of park resources.
- Provide early warning of abnormal conditions of selected resources to help develop effective mitigation measures and reduce costs of management.

- Provide data to better understand the dynamic nature and condition of park ecosystems and to provide reference points for comparisons with other, altered environments.

Ecosystem "Pinwheel" Models

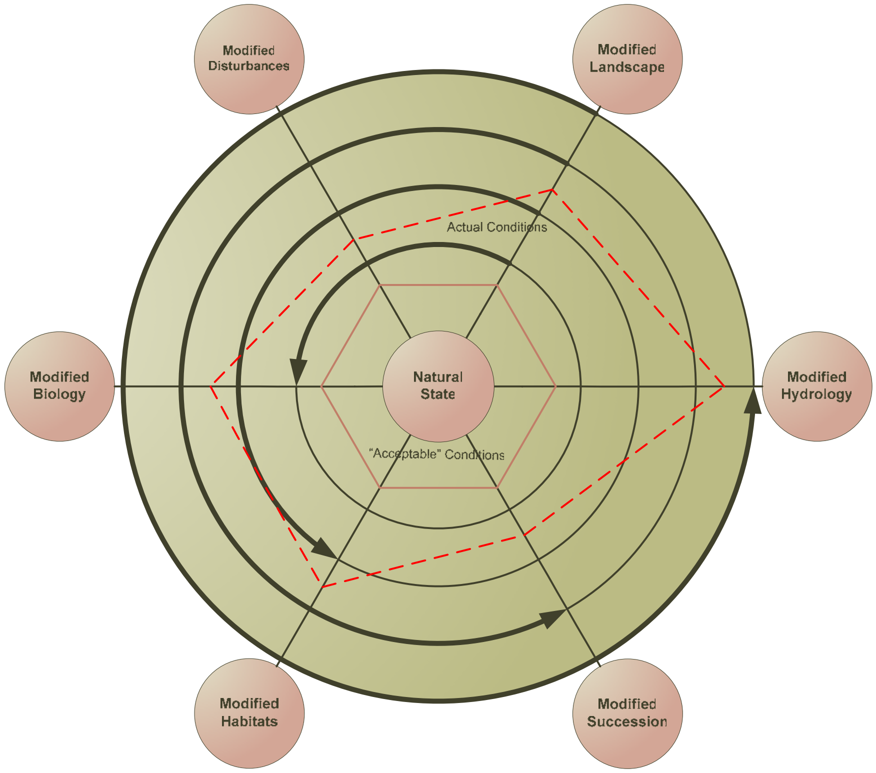
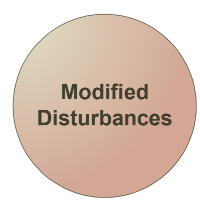


Figure 2-3. General "pinwheel" model template used by the Southeast Coast Network for description of the networks major ecosystems. Peach-colored spheres represent potential "states" of ecosystems. Arrows represent processes that move ecosystems from one state to another. The solid red line indicates conditions within the ecosystem considered to be "acceptable" given existing statutes and management plans; the dashed red line is a hypothetical depiction of "actual" ecosystem conditions.

The Southeast Coast Network has developed conceptual "pinwheel" models to describe the major ecosystems present in the network (Figure 2-3). The model assumes that each ecosystem exists in a "natural" state and that processes (natural or anthropogenic) act to push those systems to one or more modified states. The modified states fall into six broad categories: modified disturbances, landscapes, hydrology, succession, habitats, and biology as follows:

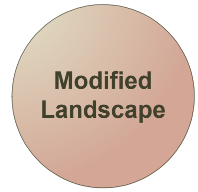
Modified Disturbances



All ecosystems are shaped to some extent by regularly occurring disturbances, which vary in frequency and intensity over time. Within the Southeast Coast Network, natural disturbances include fire, flooding, insect outbreaks, hurricanes and other high-energy storm events, and even earthquakes. Within the network, most disturbance regimes have been altered to some degree through fire suppression / reintroduction, flood control & river regulation, pest management, and potentially even global warming.

Changes in disturbance regimes can secondarily cause changes in hydrology, succession, habitats, and also the plant and animal communities on and surrounding network parks.

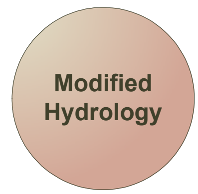
Modified Landscapes



Each park within the Southeast Coast Network is affected to some extent by both the surrounding landscape and a long history of landscape modification. However, the degree of influence from the surrounding landscape varies among the parks, and necessarily changes depending on the ecosystem being considered. The parks within the Network that have major river systems (CONG, CHAT, KEMO, HOBE, OCMU, and MOCR) are influenced by factors upstream within the watershed regardless of park jurisdictional boundaries. The coastal barrier island parks are affected by a combination of factors both upstream within their watersheds and up-shore along the Atlantic coast. For all parks, air resources are potentially affected by activities within the landscape independent of location within the watershed.

The primary driver of changes in landscapes in the southeast is the rapid population growth rate region-wide. As a result, typical landscape-level factors that affect park resources include both the type of adjacent land use, and conversion of those lands (typically residential, agricultural / forested, or urban). These changes, though landscape-scale in scope can dramatically affect local ecosystems. Local modifications to habitats, hydrology, and biology can result from landscape-scale changes in sediment budgets (in both riverine and coastal systems), water availability and use, and metapopulation dynamics.

Modified Hydrology



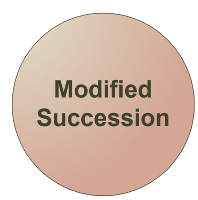
Alteration to the hydrological regime is a common disturbance in a variety of southeastern ecosystems: bottomland and floodplain forests, longleaf pine savanna, Carolina bays, Atlantic white-cedar swamps, barrier-island communities, mangrove forests, rivers, and streams (White et al. 1998). Hydrological change has altered flood depth, duration, frequency, and seasonal timing in many of these systems, leading to a raising and lowering of the water table in specific cases.

Southeast Coast Network riverine systems have been altered by human activities, including impoundment, channelization, lowering of water tables, increased runoff, acid mine drainage, air and water pollution, sedimentation, recreation, and introduced species (including mussels, fishes, and aquatic plants) (White et al. 1998). Many examples of effects on stream biota can be cited (Hackney and Adams 1992)—nearly all major stream systems have been channelized or dammed (Adams and Hackney 1992). In the Southeast, 144 major reservoirs have been built (Soballe et al. 1992), and one-third of all Florida rivers have impoundments.

Groundwater resources in the Southeast Coast Network include two major regional aquifers (the Floridan and the Northern Atlantic Coastal Plain) and multiple shallow groundwater aquifers. These groundwater resources provide both drinking and irrigation water to coastal areas and are likely to see increasing demand as the human population grows in the region.

Changes in hydrology can also secondarily cause changes in habitats succession, biology, and even disturbance regime.

Modified Succession

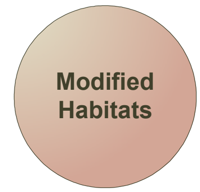


For the purposes of the pinwheel models, modified succession refers to any state where the natural evolution of the landscape has been either slowed down or accelerated. Plant communities in the Southeast Coast Network are to a large extent defined by a long history of land use practices that have altered natural succession, primarily in terrestrial habitats. Practices such as fire suppression, land conversion, agriculture, and silviculture have often focused on keeping lands in specific successional states. Conversely, altered flooding regimes (either by increasing or decreasing flooding frequency) have allowed succession within network habitats to either be curtailed or extended.

In addition to terrestrial plant communities, efforts to halt the evolution of landscapes also occur in coastal and riverine systems. Erosion control measures on coastal barrier islands through hardening and renourishment are examples of efforts to modify the rates of natural barrier island evolution. Similarly riparian zone management in river systems can lead to altered rates of stream bank erosion.

Changes in succession can directly alter habitats for dependent plant and animal species, and consequently can have dramatic effects on communities in general. Modified landscapes, disturbances, and hydrology can also lead to changes in succession.

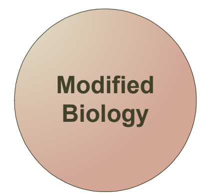
<u>*Modified Habitats*</u>



Habitats and the quality thereof are of critical importance for all organisms within network parks. For the purposes of the models described here, habitat includes all factors directly related to the *local* environments for park plant and animal resources. Factors such as fragmentation, heterogeneity, connectivity, and structural diversity are included, but also included are components such as, water quality, air quality, and soil quality.

Habitats within network parks can be influenced by either local or landscape-level processes, and can be either natural or anthropogenic in origin. Because of its direct impact on biodiversity, habitat modification is often a strategy used for managing park resources, particularly in threatened and endangered species management.

<u>*Modified Biology*</u>



Modified biology refers to changes in the biodiversity, distribution, behavioral ecology, and feeding ecology of the plant and animal species present within the ecosystem. Processes such as migration, competition, disease transmission, and predation all typify natural processes that can modify biological communities. However, other non-natural processes such as species invasions, hunting, and species reintroductions can also have dramatic impacts on communities.

Typically though, biological modifications are the “end result” of one or more processes or state-changes within the ecosystem, but in some cases can result in state changes themselves (i.e., changes in fire frequency due to altered fuel loading).

Use of pinwheel diagrams in a management & monitoring context

It is clear from these goals that a fundamental purpose of vital-signs monitoring is to detect meaningful changes in the condition (structure and functioning) of park ecosystems. It is therefore essential that conceptual models developed to support vital-signs monitoring reflect the current state of knowledge regarding ecosystem dynamics – how and why ecosystems change as a consequence of interacting natural and human factors. Monitoring can occur at one of two fundamental levels: either the processes described can be measured, or the mechanistic components describing either the process or the results (modified disturbance, landscape, hydrology, succession, habitats, or biology).

Finally, more detailed mechanistic models can be developed to further describe the processes included in the pinwheel diagrams. In such models, the environmental setting, resources of concern, and agents of change can be linked to expected ecosystem responses. From a management standpoint, both the status of the ecosystem and the trends either toward or away from an acceptable state might be important (Figure 2-3). Detailed descriptions of the key mechanistic components of Southeast Coast Network ecosystems can be found in Appendix 7.

Network Ecosystem Models

The Southeast Coast Network has developed pinwheel models for three major ecosystems found within the network: inland aquatic systems (rivers & streams), terrestrial systems, and coastal aquatic systems (nearshore marine and estuarine). For each modeled ecosystem, we have developed both the pinwheel models and textual descriptions of key model components (found in Appendix 7). Pinwheel models present hypotheses concerning relationships of selected components of the ecosystems and how or why they might change over time. Mechanistic models provide details concerning the actual ecological components and processes that are involved in the dynamic models.

Rivers & Streams

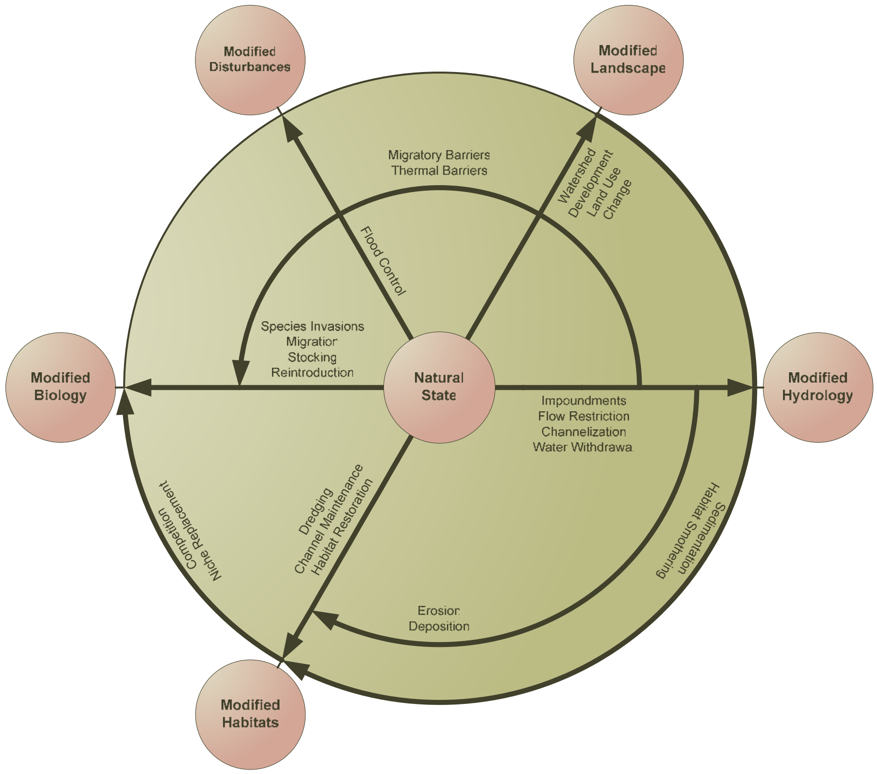


Figure 2-4. Model of ecosystem dynamics in rivers and streams within the Southeast Coast Network.

River systems in the Southeast generally follow trends as described in Vannote et al.'s (1980) River Continuum Concept, which describes linkages between streams, floodplains, and the watersheds that they drain along a longitudinal gradient from the headwaters to the sea. The River Continuum Concept maintains that biological, physical, and chemical properties and functions of river systems and their associated floodplains follow a general pattern from their headwaters to their mouths due to changes in elevation, geomorphology, amount of water, and the amount of light.

Southeast Coast Network parks contain significant riverine resources within three distinct zones along the river continuum—CHAT and KEMO are located in the Piedmont province, HOBE and OCMU are on the fall line, and MOCR and CONG are located within the coastal plain. Coastal parks within the network also contain smaller isolated systems.

Recognizing that rivers are highly dynamic in both space and time, several processes have been identified that cause rivers and streams to evolve from natural to modified conditions (Figure 2-4). Four distinct modification types exist for riverine ecosystems: habitat modification, hydrologic modification, watershed modification, biological modification. Although natural disturbances cause local or system-wide modifications to one or more of these components, these variations are considered to be a part of the natural state. Key processes that drive the natural system to one or more of the modified states include flow restriction and redirection, water withdrawal, species introductions, erosion, competition, migration, and restoration (Figure 2-4). In some cases, changes from the natural state to a modified state can cause further modifications (i.e., modifying hydrology can cause changes in habitats and therefore changes in community structure).

Southeast Coast Network streams and rivers are in a modified to highly modified state due to a combination of river regulation and rapid changes in land use that have resulted in extreme changes in water quality, habitat quality (through sedimentation) and aquatic community structure. Southeastern streams that were once dominated by coarse woody debris and gravel-bottom substrates have seen those substrates either cleared or buried, and many sensitive species (such as mussels) have been extirpated as a result.

Estuaries & Nearshore Marine Systems

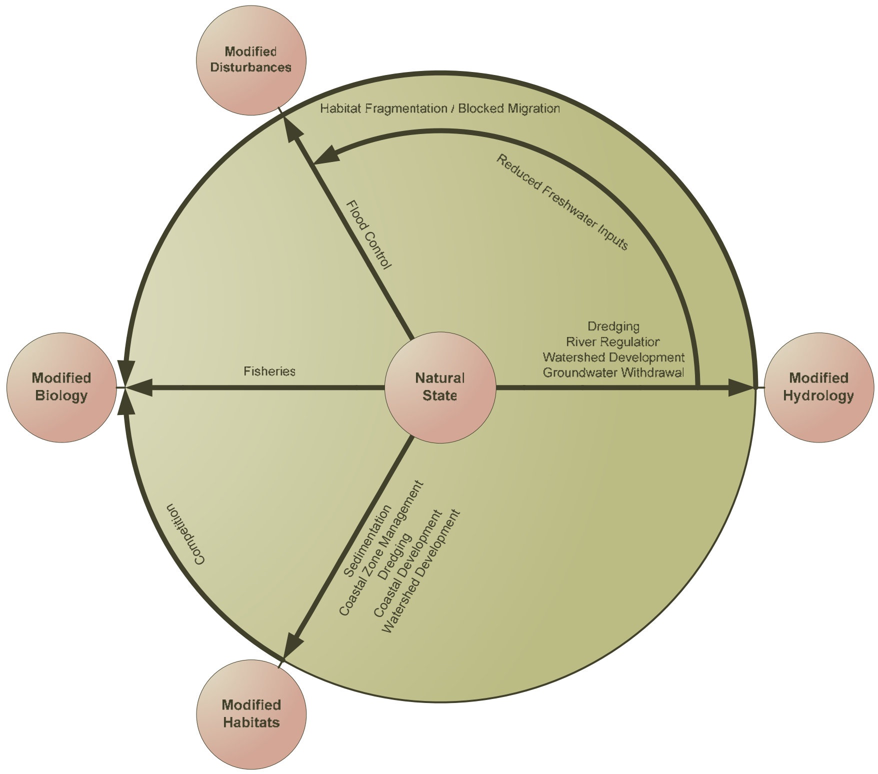


Figure 2-5. Model of ecosystem dynamics in estuaries and nearshore marine areas within the Southeast Coast Network.

The Southeast Coast Network contains seven parks with significant portions of estuarine and nearshore marine systems (CAHA, CALO, FOSU, FOPU, CUIS, TIMU, and CANA). Estuarine systems are particularly sensitive to changes in hydrology; particularly those that can affect salinity levels.

The major drivers of ecosystem change in estuarine and nearshore marine systems include coastal zone management (dredging, beach renourishment, and shoreline stabilization projects), fisheries, adjacent land use development, and hydrological modifications resulting from both upstream river regulation and groundwater extraction (Figure 2-5). Potential changes to the ecosystem include modified hydrology (flushing), modified disturbance regimes (flooding frequency), modified habitats (a combination of changes in sand / sediment budgets and water quality), and resultant shifts in community structures or distributions.

Most parks within the network (even within the coastal parks) do not have jurisdiction within estuarine or marine systems. However, many resources within park boundaries rely on estuarine or nearshore marine systems for part of their life cycle.

Terrestrial Systems

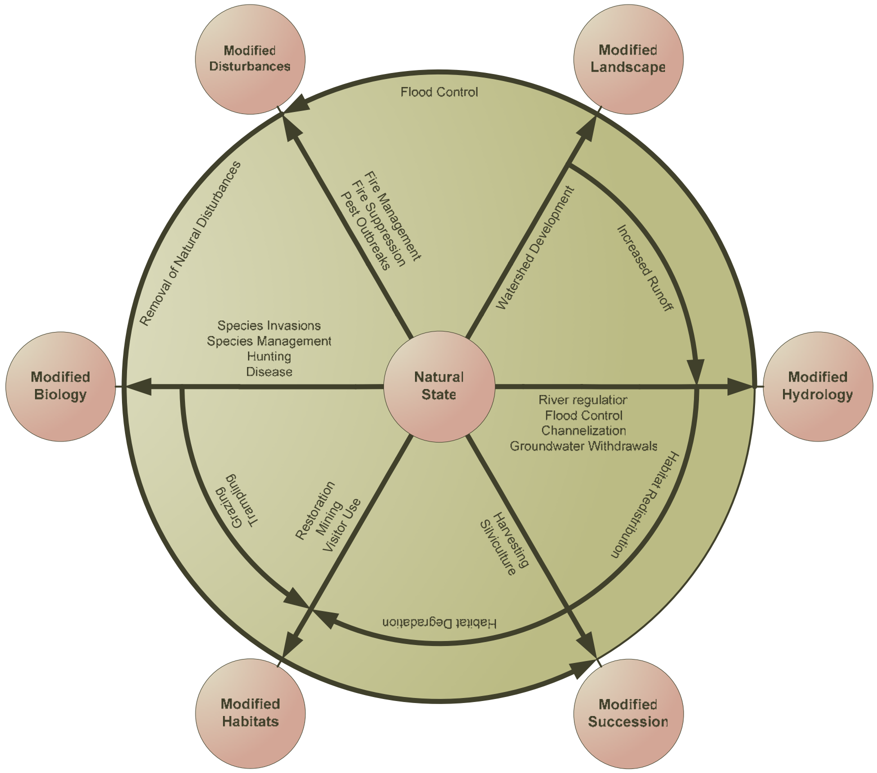


Figure 2-6. Model of ecosystem dynamics in terrestrial systems within the Southeast Coast Network.

Terrestrial systems within the Southeast Coast Network are very diverse, ranging from upland and bottomland forest communities to coastal dune ecosystems. Included in these systems are many plant and animal species of management concern (native, exotic, common, and rare).

Natural systems within the network are marked by high levels of plant diversity, and more often than not historical dependence on fire or flooding as significant landscape-level drivers of ecosystem function (Figure 2-6). However, agents of change exist at all spatial and temporal scales in terrestrial ecosystems. Wildlife disease, species invasions, visitor use impacts, and changes in adjacent land use are all significant drivers of ecosystem structure, function, and composition.

3. Vital Signs

During the last twenty years, indicator-based monitoring programs have been developed to assess almost every ecosystem type around the world. Recent syntheses have focused on topics such as qualities of “good” vs. “bad” indicators, statistical sampling design, and methods to integrate monitoring programs with adaptive management programs—all in an effort to ensure that new programs meet desired objectives (Busch and Trexler eds. 2003). However, to date no adequate discussion has occurred about methods for selecting *what* indicators to monitor in the context of an integrated monitoring program when multiple options exist. The need to select indicators based on sound, defensible methods is critical to program success, particularly as new monitoring programs are intended to support an increasing number of management goals for an increasing number of partners.

Two critical facts – that the networks are operating under significant budget constraints, and that the scarce resources necessary for the parks and networks to achieve their goals are being allocated from a common pool – necessarily mean that the procedures by which decisions over resource allocation are made will be as important as the actual ecological priorities themselves. That is, the same set of ecological priorities will lead to more or less efficient resource allocation decisions depending on the decision-making procedure. Thus, without careful consideration of the decision-making procedures, in all likelihood resources will be substantially under-utilized (Morrow 1994). Recognizing this, the Southeast Coast Network developed methods for vital sign *selection* prior to beginning the vital sign scoping process in earnest (Table 3-5; also see Appendix 4).

Resource Allocation Approach

Given the conditions of limited resources, and the need to divide those resources among multiple partners, resource allocation is as much dependent on the *process* as it is on the criteria for dividing those resources (Kreps 1990). Specifically, the Southeast Coast Network desired a selection method that explicitly accounts for:

- Assessing indicator utility based on synergism or redundancy with other indicators, in addition to technical merit. This implies focusing on *suites* of indicators rather than individual indicators.
- Incorporating individual Parks’ needs and priorities into the decision-making process.
- Incorporating sociopolitical or other non-technical factors into the decision-making process in a formal and documentable manner.
- Developing legitimate alternative choices, all of which (a) meet minimum standards and needs of all parks within a network, and therefore (b) represent viable choices for implementation.
- Providing a framework for selecting alternatives, and modifying those choices at a later time.

The decision-making process that follows addresses the needs identified above, and is based on Bator’s (1957) economic model designed to determine the best and most efficient distribution of multiple products to multiple constituents given limited resources. The underlying principle is to identify how an altruistic agent, who perfectly incorporates the interests of all of the relevant actors, would choose to allocate the existing resources. By doing so, the model identifies one or more solutions that cannot make any one actor better off without making the group as a whole worse off. The model has been modified for multiple applications such as to advise crop rotation planning, company expenditures, and distribution of air pollution credits (Bator 1957, Mclure 1968, Laudadio 1971, Grabowski and Mueller 1972). In each case the authors created a model to guide production levels that is inherently linked to both individual customers’ preferences, and production costs.

Welfare Maximization is a three-step process:

1. Maximizing Production Efficiency. All possible combinations of resource allocation such that an increase in production of one product necessitates a decrease in production of another. Allocations that meet this criterion maximize production efficiency within budgetary or other resource constraints.

2. Maximizing Product Utility. Based on customers' preference, identify those resource allocations such that an increase in satisfaction for one customer necessarily decreases the satisfaction of one or more other customers.

3. Defining Constrained Bliss. From the combinations of production that both maximize production efficiency and utility, select the one production function that best meets the welfare of all customers. In this case, welfare is defined by the ethic of the group to whom the products are intended (*not* necessarily scientific).

For the purposes of monitoring program design, the model needs to be modified slightly such that the program is designed to produce answers to specific monitoring questions (the "products"), for fifteen Park units (the "customers") with differing preferences for those products. In such a program the Network will implement monitoring protocols (collection of indicators) designed to answer to one or more of the identified monitoring questions. A successful Vital Signs Monitoring Program under this model will be a balance of indicators (the "costs" of production) that maximizes the number of high priority and total questions answered at all parks.

Pivotal to the process are two explicit qualifications. First, all protocols must be related to one or more specific monitoring questions identified by at least one park within the network. Second, protocols may consist of single indicators, collections of indicators, or indicators and other associated information.

Given this framework, monitoring program design proceeds as follows:

1. Maximize Monitoring Efficiency: Identify all possible suites of indicators that can be implemented within varying budget constraints. At this point, each suite is a potential monitoring program. If one or more of the indicators can be removed from a suite without reducing the *number of questions* answered, the combination of indicators is inefficient and not considered further. The resultant set represents potential programs that maximize production efficiency.

2. Maximize Information Utility: Based on parks' priorities for receiving answers to specific monitoring questions, select from the set of efficient program possibilities those combinations of protocols that maximize (a) the total number of questions answered, (b) number of high-priority questions answered, and (c) average priority level of questions answered *for each individual Park*. At any given budgetary level, the resultant suites of indicators represent monitoring programs that can be implemented. In each case implementation of any of the alternative options would satisfy the needs and expectations of all Parks in the most efficient means possible.

3. Choose the Most Relevant Alternative: Select one option from the alternative potential programs for implementation based on qualities deemed important to the Parks and other stakeholders. This step assumes that although all potential alternatives represent desirable outcomes, some might be more relevant than others. Selection criteria can include scientific, social, or political considerations, and can be explicitly documented. This step is particularly suited toward a consensus-building process because regardless of the outcome, all parties are guaranteed a program that maximizes both utility and efficiency.

Process of Vital Signs Selection

The Southeast Coast Network is roughly two-thirds through the vital signs selection process (Table 3-5).

Table 3-5. Summary of the process used in the Southeast Coast Network to choose and prioritize Vital Signs.

Dates	Event	Purpose	Product
07/02 – 07/03	Scoping meetings at each park	Identify key natural resource issues at each park within the Network, and develop specific monitoring questions of interest.	Appendix 5 – Summary of Natural Resource Issues at SECN parks.
09/03 – 12/03	Developed new methods for vital sign selection	Develop both satisfactory and scientifically defensible methods for vital sign selection (not prioritization) to guide the process.	Appendix 4 – Methods for vital sign selection in the SECN. Developed in partnership with Emory University.
12/03– 12/04	Develop Vital Signs Selection Database Software and analysis tools.	Facilitate scoping meetings, reporting / synthesis of findings, and selection process as developed above.	
12/03 – 02/04	Review of Phase I and Phase II reports from first two cycles of Networks	Identify specific monitoring questions that have been relevant in other networks nationwide.	Appendix 9 – Monitoring program priorities for SECN parks
02/04 – 06/04	Scoping meetings at each park	Prioritize natural resource information needs around which a monitoring program can be designed.	Appendix 9 – Monitoring program priorities for SECN parks
08/04 – 12/04	Identify protocols / methods that can be used to answer monitoring questions of concern to the Network	Link potential vital signs to park priorities for getting answers to specific monitoring questions.	Prioritized list of Vital Signs
12/04 – 02/05?	Develop program alternatives	Use resource allocation models developed above to identify multiple sets of vital signs that can be implemented to answer priority monitoring questions.	
TBD	Review and Comment	Submit report of methods and potential monitoring programs to subject matter experts for comment and review.	
TBD	Full Network Meeting	Select vital signs to be implemented from among the alternative programs presented.	Final list of vital signs to be implemented by the monitoring program

6. Data Management and Archives

As part of developing a long-term monitoring program, the Southeast Coast Network is conducting an information needs assessment within the context of previously developed monitoring priorities identified in Appendices 5 and 9. This process mirrors that of selection of Network vital signs by conducting a series of targeted scoping meetings to clearly define park information needs and to develop conceptual data models. Utilizing information from these scoping meetings, a data management plan will be developed to support the needs of the parks and other stakeholders. The Network is currently in the process of undertaking the first steps of the process:

1. Individual park scoping meetings to identify available (and needed) data sets, training needs, and park information management capacity and capabilities – to serve as background information for the information needs assessment process and network data mining activities (Completed 07/04).
2. Identification of critical information product needs of the parks, the SECN Inventory and Monitoring Program, and for key partners,
3. Identification of a suite of data products necessary to support park, programmatic and partner needs and identify their cost, and
4. Development of a conceptual data object model that illustrates information flow within the program and describes programmatic responsibilities of involved personnel,

The process will inform the development of the data management plan as well as provide critical insight into the sampling and reporting needs to be considered during protocol development.

Information Needs Assessments

The Network will hold at least three meetings in FY2005 to conduct information needs assessments (INAs). Prior to conducting the INAs, the Network has identified key business needs (Table 6-6). Meetings in FY2005 will focus on defining the monitoring information needs of Park, Network, and Regional staff, and will focus defining those needs from an "end-user" perspective. The INA process will be conducted following the methods of (Tomlinson 2003).

Table 6-6. Key business areas of Southeast Coast Network parks that will govern the types of information products that will be produced and requisite information management strategies.

Category	Key Business Area	Description
Trends Monitoring	Water Quality	
	Water Quantity	
	Geology & Geomorphology	
	High-Priority Ecosystems & Habitats	
	Species of Management Concern	
Program Monitoring	Exotic Plant Management & Control	
	Fire & Fire Effects	
Project Management	Museum Management	
	Document Management & Archives	

Information Product Descriptions

Based on findings from the INA process, the Network will develop detailed information product descriptions (IPDs). Each IPD will include a description of the information product (i.e., map, image, table, documents, etc.), intended audience, frequency and purpose of use, and the data required to develop those products. IPDs will be cataloged in a central database for use during protocol development.

Conceptual Data Object Model

Based on the information needs assessment and the ecological relationships among resources within the SECN, a conceptual data object model will be created to serve as the framework for designing an information management system.

8. Administration / Implementation of the Monitoring Program

Coordination among Network Parks

Network member parks are committed to cooperate and foster an atmosphere of fairness, trust, and respect throughout the Network. They are pursuing an inclusive approach in defining Network management issues and resources of concern, and in identifying the best locations to monitor these resources, as well as implementing the I&M program using scientifically credible standards.

Board of Directors

The SECN Board of Directors (Board) is comprised of five Network park Superintendents and the Southeast Region I&M Coordinator, with one superintendent elected to serve as the chairperson (Figure 8-7). Board member Superintendents serve for three years, while the Chair serves for two years. The Chair leaves the Board after serving as Chair. Terms are renewable other than the Chair, which rotates off at least one year after serving as chair. At a minimum, one new board member is added from the remaining parks every two years at the time a new chairperson is selected. Vacancies will be filled by the Chairperson with the concurrence of the remaining Board. The SER I&M Coordinator is a permanent member of the Board. The SECN Coordinator and Chairperson will facilitate meetings and communications of members and with all network parks. The SECN Coordinator will serve as advisor to the Board of Directors.

The Board promotes accountability and effectiveness by reviewing progress toward goals, quality controls, and Network expenditures. The Board collaborates with the Network Coordinator, Technical Steering Committee, and Network parks' natural resource staffs in the overall design and implementation of vital signs monitoring and in other management activities related to the Natural Resource Challenge.

Technical Steering Committee

The Technical Steering Committee is comprised of resource managers (elected by the Network Park Resource representatives with the concurrence of their Park Superintendent), and non-voting, volunteer scientists as needed. The Committee includes the Network Coordinator, Data Manager, CESU coordinator, park natural resource managers, and other scientists with knowledge of sampling procedures, monitoring techniques, and statistical methods that serve as reviewers to evaluate conceptual designs, monitoring strategies, and ecological relevance of monitoring proposals.

The Technical Steering Committee advises the Board and Network parks on the development of the Network Monitoring Plan and identification of monitoring objectives by:

- Compiling and summarizing existing information about park resources and the findings and recommendations of scoping workshops,
- Assisting in the development of a network monitoring strategy,
- Assisting in the selection of Vital Signs
- Evaluating initial sampling designs, methods, and protocols to ensure that they are scientifically credible,
- Participating in the development of the Annual Work Plan and Annual Reports
- Reviewing annual data reports, I&M deliverables, and otherwise acting as a peer science review group, and
- Developing materials for and facilitating the Five Year Program Review

Products and recommendations of the Technical Steering Committee are presented to the Board of Directors for discussion, modification, and approval. When necessary, the Network Coordinator may recommend to the Board of

Directors the formation of groups of scientists or specialists from within or outside the Technical Steering Committee to accomplish specific studies/tasks.

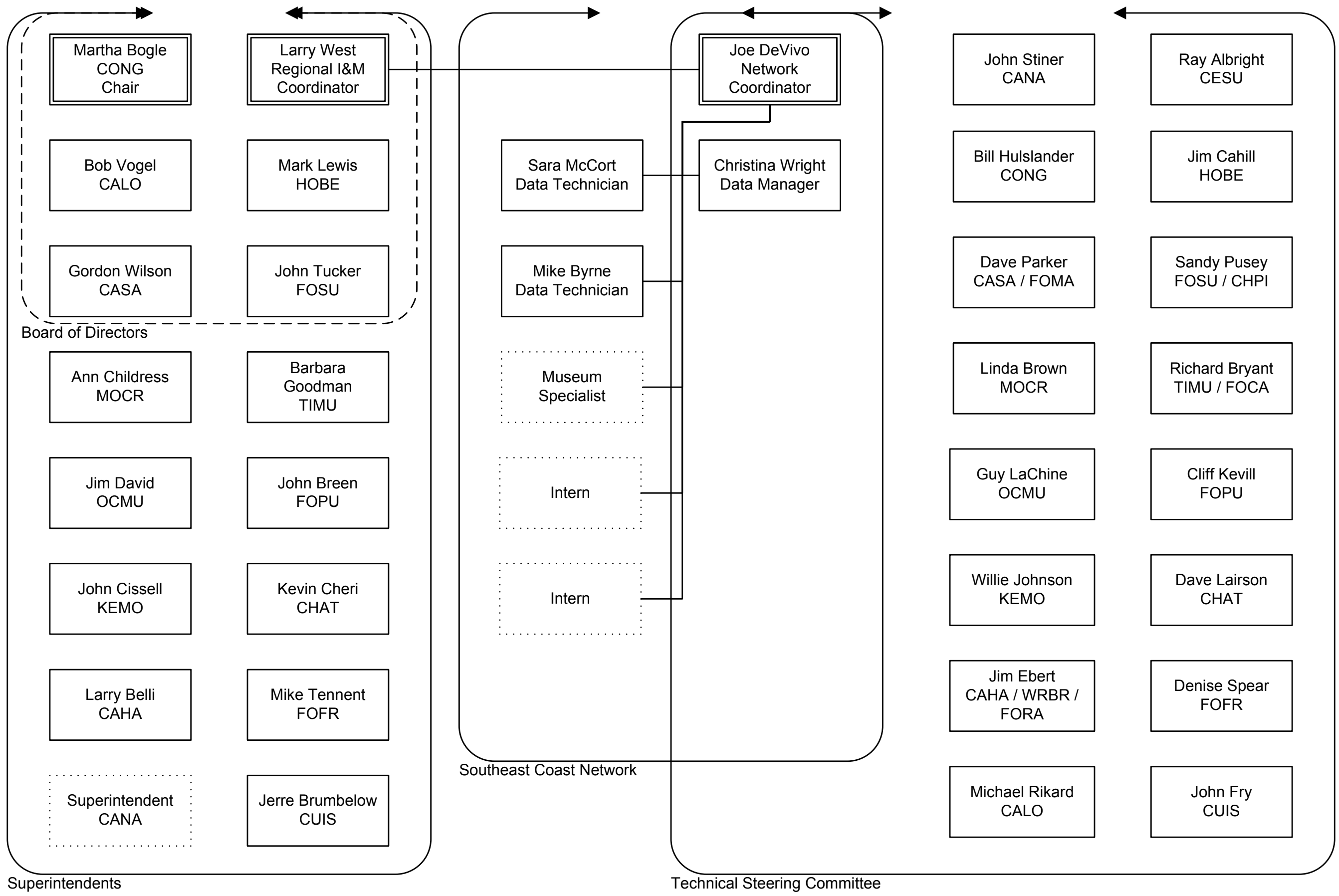


Figure 8-7. Current organizational and staffing plan for the Southeast Coast Network (08/09/2004).

Network Staffing Plan

To be completed during Phase III

Partnerships

To be completed during Phase III

Programmatic Review

The SECN I&M Coordinator, in consultation with the Technical Steering Committee and other designated subgroups, prepares and presents a draft Annual Report to the Board of Directors for consideration and approval on or before October 30th each year. Annual Reports detail specific accomplishments, products, lessons learned, coordination with others, and a budget summary. A detailed accounting of all SECN I&M program funds allocated to each park and office will be appended to and made part of the Annual Report.

At the end of the fifth Fiscal Year of Vitals Signs Monitoring, and every five years thereafter, the Network will undertake a comprehensive program review. The review shall be conducted by National Park Service specialists at the national and regional levels, and may involve qualified independent specialists from other agencies and organizations. The purpose of these reviews is to evaluate accomplishments, products, and protocols used for gathering data, data management, fiscal management, and staffing. Program Reviews provide the basis for any significant changes in program direction or reassignment of resources to any park or office with the approval of the Network Board of Directors.

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Appendix 1 – Charter of the Southeast Coast Network

Appendix 2 – Legislation and Policies Relevant to Vital Signs Monitoring in the Southeast Coast Network

Appendix 3 – Summary of Existing & Historic Monitoring Data Relevant to the Southeast Coast Inventory & Monitoring Network

Appendix 4 – Methods for Vital Signs Selection within the Southeast Coast Inventory & Monitoring Network

Appendix 5 – Summaries of Natural Resource Issues at Southeast Coast Network Parks

Appendix 6 – Maps of Southeast Coast Network Parks

Appendix 7 – Conceptual Models of Southeast Coast Network Ecosystems

Appendix 8 – Water Resources of Southeast Coast Network Parks

Appendix 9 – Monitoring Program Priorities for Southeast Coast Network Parks

Appendix 10 – Protected Species of the Southeast Coast Network

Appendix II – Air Resources of the Southeast Coast Network